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ENGINEERING NEWS.

THE NEW CROTON AQUEDUCT, is rapidly nearing completion. Chief Engineer FTELEY reports that Section 1 of the aqueduct is nearly done; Sections 2, 3, and 4 will be completed in a few weeks; Section 5 has been accepted; Section 6 should be completed this year; Sections 7 and 8 ought to be done in two months with proper diligence; Sections 9, 10 B, and 11 A promise considerable delay on account of the unsatisfactory methods of the contractors; Sections 13, 14, and 15 are completed; Section 15½ will be within two months; Section 16, the pipe line, will be ready by May 1, 1890; and Section 17, the Central Park gate house, will be done at the same time. The draughting force is engaged in preparing plans for the new work on the dam, and the field force will be fully occupied for some time yet on the same work. Reductions are being constantly made elsewhere in the list of commission employés, and the offices at South Yonkers are closed.

APROPOS OF THE CHANNEL TUNNEL and the violent objections to it by certain Englishmen, as inviting invasion from France, the objectors should be reminded that the Duke of Wellington, for a similar reason, opposed the construction of the proposed railway from Portsmouth to London. But the railway was built; and the tunnel will probably be also constructed, as the most feasible, economical, and sensible way of crossing the British Channel.

THE PROPOSED BOAT RAILWAY at the Dalles of the Columbia River is opposed by Governor PENNOYER, of Oregon, in a letter to the Chief of Engineers. He suggests the construction instead of an ordinary standard-gauge railway, which could be built complete within one year, with the necessary rolling stock, wharves, etc., at a cost of not more than $500,000.

THE CACHE LE POUDRE RIVER is being accurately gauged and surveyed by Mr. E. S. NETTLETON, U. S. Supervising Engineer, and other engineers of the U. S. Geological Survey and the State Engineers' office, to exactly ascertain the amount of seepage water gathered by this stream, from the cañon to the Platte River.

A LAKE ERIE SHIP CANAL COMMISSION has been appointed by Gov. BEAVER, of Pennsylvania, to report upon the feasibility of constructing a ship canal connecting Lake Erie and the Ohio River. The commissioners are JOHN A. WOOD, REUBEN MILLER, W. S. SHALLENBERGER, EBEN BREWER, and JOHN M. GOODWIN.

THE MICHIGAN SHIP CANAL has been voted an appropriation for a preliminary survey by the Grand Rapids Board of Trade. The proposed route is from Holland, Mich., to Grand Rapids. A low valley or old river bed lies on the line, which would be 25 miles long. Congressman C. E. BELKNAP proposes to first seek government aid; but failing that, he says, the canal will be built by private subscription.

STATE PURCHASE OF THE ENGLISH CANAL SYSTEM, says the *Glasgow Herald*, is contemplated, and papers have been forwarded from the Board of Trade to the various canal companies and trusts, requesting information of a very complete character in view, it is believed, of legislating next session of Parliament for the acquisition of the entire canal system of the country by the Government. It is understood that leading men of all parties, recognizing the difficulty of dealing effectually with the question of railway freights under the present system, have given their adherence to the principle of the State acquiring the canals. The rumor is given for what it is worth.

THE PROPOSED FORTH AND CLYDE SHIP CANAL is again commanding attention. Two routes have been suggested; the first from the Clyde to Loch Lomond by way of the River Leven, and from the loch along the Endrick Valley to Sterling and Grangemouth. The total distance from the Clyde to the Forth would be about 50 miles. An alternative route, which meets with favor, leaves the Clyde about three miles west of Glasgow, passes to Maryhill and the present canal. There would be a rise of 130 ft. in this first three miles and a similar fall at the other end. The estimated cost of the plan most favored is about $35,000,000.

SURVEYS FOR AN IMMENSE DAM AND RESERVOIR on the Genesee River near Mount Morris, N. Y., are now in progress. The work is under the direction of State Engineer JOHN BOGART, and is being done in accordance with an act of the last Legislature. It is said that the proposition is to construct a dam 125 ft. high, to store water to supply one of the feeders of the Erie Canal and also to supply the city of Rochester.

THE ESTIMATE FOR PUBLIC WORKS, for the year ending June 30, 1891, as given in the annual report of Gen. CASEY, Chief of Engineers, foots up to a total of $30,186,300 for river and harbor improvements. The total of the appropriation of the previous year was $22,397,617. The larger items in the present estimate include $1,030,000 for the Tennessee River above and below Chattanooga; $1,236,000 for the St. Mary's River at the Falls; $1,000,000 for the Mississippi between Minneapolis and Des Moines; $1,100,000 for Galveston Harbor; $1,400,000 for the Columbia River improvement, etc. The Mississippi River Commission recommends an appropriation of $5,586,250 for work at the mouth of the Ohio River, at Hickman, Greenville, Vicksburg, Natchez, and New Orleans, and the rectification of the Red and Atchafalaya Rivers. The Missouri River Commission also asks for $2,760,000 for special work at Sioux City, Omaha, Plattsmouth, Nebraska City, Rulo, St. Joseph, etc.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was the derailment of a construction train, Oct. 19, near Confluence, Pa., on the Confluence & Oakland Ry., a new line built to connect with the Baltimore & Ohio. The train was being pushed slowly along, when the first car left the track and three others were piled up in a wreck. One of the cars was crowded with men and another was loaded with rails. There were 3 men killed and 2 injured. ——Four cars of a fast train on the Atchison, Topeka & Santa Fé R. R. were derailed and thrown down a bank by a broken rail near Dodge City, Kan., Oct. 18. The engine and baggage car kept the track. Several persons were injured but nobody was killed. ——A collision occurred Oct. 17 on the Boston & Maine R. R. near West Canaan, N. H., between a double-header south-bound express and the rear end of a freight train which had been pulled onto a side track leaving the three rear cars on the main track. Both passenger engines and several freight cars were wrecked, but nobody was killed. The responsibility is said to rest with the crew of the freight train, and the flagman had not gone far enough back.——Nine cars of a passenger train on the Denver & Rio Grande were blown over by the wind near Farmington, Utah, on Oct. 13. Several persons were injured, but none killed. Similar accidents occurred in the same locality 7, 2½, and 2 years ago. The winds come down the cañons with great force. ——The boiler of a Chicago & Grand Trunk locomotive exploded Oct. 22, at Granger, Ind., killing the engine-driver and fireman. Low water is given as the cause of the accident.

BRIDGE ACCIDENTS are reported as follows: A temporary bridge carrying the Georgia, Southern & Florida Ry. over the Suwanee River, near Lake City, Fla., gave way recently.——The false work of the second span of the new iron bridge over the Susquehanna at Harrisburg, Pa., was blown down Oct. 14, and the part of the iron work already erected fell with it.

THE BERLIN DAM ON THE FOX RIVER, above Eureka, Wis., broke Oct. 14. The loss of the dam will seriously impede navigation on the river above. Probably it will be rebuilt at once. During the past few weeks the river has been very low, and it is thought by some that sun and wind opened crevices in the dam, making leaks that resulted in its failure.

A SEVERE DROUGHT is being experienced in some parts of Minnesota, Dakota, and Iowa, and has caused much suffering. It is hoped that rain will fall before the winter cold sets in.——Forest fires have been doing great damage in Wisconsin, Louisiana, and other States.——Snow has fallen in Maryland and Virginia.

THE WALL OF THE WATER POWER CANAL at Kimberly, Wis., gave way Oct. 20, causing damage to the paper mills amounting to nearly $10,000.

A VEIN OF NATURAL GAS was struck Oct. 20, by the men engaged in sinking the caisson for the intermediate shaft of the new water tunnel under the lake at Chicago, Ill. The gas caught fire, and five men were burned, two of them seriously.

THE PULLMAN PALACE CAR COMPANY'S annual report shows a total gross income from sales of manufactured products during the year of $8,652,746. Besides this, the company received $1,735,417 for rentals at Pullman. The works at Pullman built during the year 141 sleeping, dining, parlor, and special cars, costing $2,511,596, an average of $17,813. The average number of names on the pay rolls at Pullman was 4,541. The wages paid amounted to $2,629,531, an average for each person employed of $579.06, against $604 during the previous year.

The total number of persons in the employ of the company is 11,063. Wages paid during the year amounted to $5,770,345. There are 1,760 standard cars and 239 tourist or second-class cars now in the Pullman service. During the year the total car mileage was 144,842,618, and the total number of persons carried was 4,242,542. The total extent of railways on which Pullman cars are now run by contract with the railway companies is 117,854 miles, an increase of 11,723 miles over the preceding year.

THREE OCEAN STEAMERS of 6,000 tons each are to be built for the Canadian Pacific Railway Company by the Barrow Shipbuilding Company. They are to ply between Vancouver and Asiatic ports. The company has not yet decided whether the proposed fast Atlantic liners shall be operated by a separate company or shall be managed directly by the Canadian Pacific.

CHAIRMAN WALKER, of the Interstate Commerce Railway Association, has presented his decision on the petition of the Chicago, Milwaukee & St. Paul Company for leave to make the same rates on coal from Chicago and Milwaukee to points in Minnesota and Dakota as are made by the Lake Superior lines from Duluth and Gladstone.

Mr. WALKER advises that the proposed reduction be postponed until a conference is had with the Lake Superior lines, with a view to an equitable adjustment of rates. It is further recommended that to points in northwestern Iowa, Minnesota, and Dakota, reached only by lines which are members of the Association, the rates be made the same from Duluth as from Milwaukee and Chicago.

THE WESTERN UNION TELEGRAPH CO., says its President, Dr. NORVIN GREEN, has 7,000 miles o telegraph wire now strung along the elevated railway structures of this city, for which disposal h has the permit of the courts. Dr. GREEN says that New York presents peculiar difficulties to subway disposal of wires in the great amount of sewer and coal gas saturating the soil. He claims that this gas will in time rot any gutta percha insulation of wires. But how about lead-covered cables? As far as the insulation is concerned, it would seem that the hauling of wires though the present small subway tubes would be very liable to scrape off almost any insulating material that could be put on them as single wires. These small, inaccessible tubes form one of the very faulty features of our new subways.

ADMISSIONS TO THE PARIS EXPOSITION from ept. 1 to Sept. 15 inclusive, numbered 2,610,211. The greatest number in any one day was 307,106. The total admissions to date of Sept. 15 were 17,172,073. The corresponding figures for the Exhibition of 1878 were—Sept. 1 to 15, 1,162,112; total to Sept. 15, 8,112,296, or about one-half of the present total. *Le Génie Civil* gives the following comparisons of attendance, total and daily, at the preceding great Exhibitions:

Date and Place.	*Total Attendance*	*Daily Average.*
Paris, 1878	12,500,000	70,000
Philadelphia, 1876	10,000,000	61,000
Paris, 1867	9,000,000	42,000
Vienna, 1873	7,000,000	40,000
London, 1851	6,000,000	40,000
London, 1862	6,000,000	34,000
Paris, 1855	4,500,000	24,000
Paris, 1889 (to Sept. 15)		130,000

THE EIFFEL TOWER WAS AN AMERICAN IDEA, frankly says M. EIFFEL in a late paper read by him in Paris. This now eminent engineer states that his first suggestion of the tower came from a letter of Mr. DAVID REEVES, then president of the Phœnix Bridge Co., as published in the *Scientific American* of Jan. 24, 1874. Mr. REEVES then proposed for the Centennial a tower 1,000 ft. high and 150 ft. in diameter on a circular base, composed of twenty inclined Phœnix columns horizontally braced at intervals of 30 ft. M. EIFFEL can, however, claim for himself a novelty and grace of execution that was not inherent in the American design.

AN EIFFEL TOWER FOR LONDON is now proposed, and a company has been formed there for the purpose of erecting it. The tower is to be 1,250 ft. high. £500 is offered as a prize for the best design for the proposed tower, and £250 for the second best design. The competition is open to the world.

A LOT ON BROADWAY and the southwest corner of Liberty St., 50 ft. on Broadway and 120 ft. on Liberty St., could have been sold last week for $1,200,000, but the offer was refused. This is at the rate of $200 per sq. ft., or $8,712,000 per acre. Land at the corner of Wall St. and Broadway has been sold at $30,000,000 per acre, but this Liberty St. lot is tolerably costly.

A NEW SWEDISH EXPLOSIVE is called "gray powder" or *grakrut*. It is invented by Mr. J. W. SKOGLAND, a Swedish engineer. As used in Nordenfeldt machine guns; and 70 per cent. of the *grakrut* has imparted 33 per cent. greater initial velocity to the projectile than the usual charge of ordinary powder, taken as 100 per cent. And it did this with only an increased pressure in the gun of 5 per cent. With 62 per cent. of gray powder, the initial velocity was increased 24 per cent. without increase in gun pressure. With 74 per cent. of the ordinary charge the velocity increase is 40 per cent. without undue pressure. The new powder only leaves a transparent steam, visible for five seconds, on discharge.

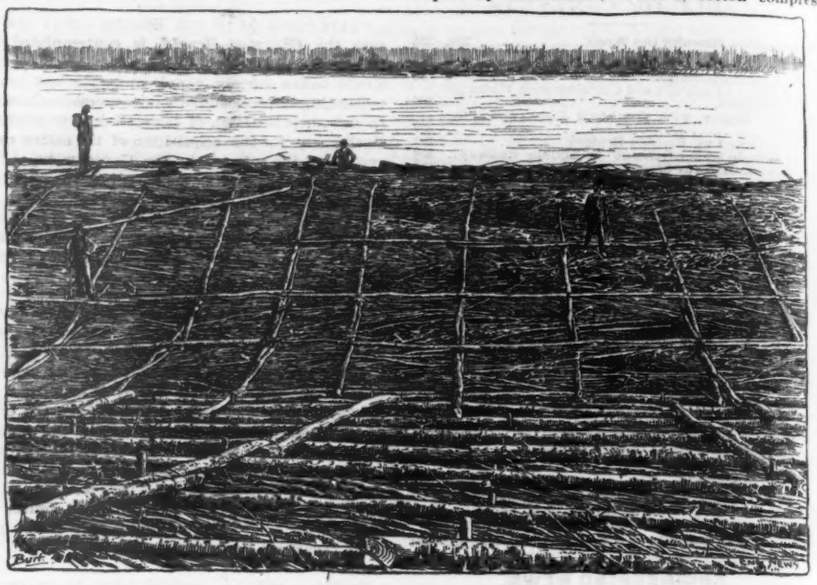
IN DESCRIBING THE RECENT ACCIDENT AT PALATINE BRIDGE, one of our contemporaries in the railway field says:

> The engineer of the first section suddenly found his engine to be in trouble— a steam chest cover blew off—but instead of stopping at once he went ahead with one cylinder. . . . . After slowly pulling along in this crippled condition for some, time a stop became necessary.

Evidently the mechanical editor of our contemporary's staff is on his vacation. When he returns we would suggest to him the problem: how much can a locomotive pull with one cylinder, with the steam chest on the opposite side open to the atmosphere?

Government Protective Works on the Mississippi River, at Plum Point and at Memphis, Tenn.

The illustrations here given of dike construction on the Mississippi River, at Plum Point, are made from photographs kindly sent this journal by Capt. SMITH S. LEACH, U. S. Engrs., the officer in charge of the First Division of the river improvement work. The four larger cuts practically speak for themselves. Fig. 1 shows the process of weaving the mat, and is an inshore view of the mat as it lies on the launching ways, as shown in Fig. 2; Fig. 4 is a mat, built afloat and afterwards grounded by the falling of the river level; and Fig. 3 shows the completed revetment with a mid-stage river.



Weaving the Connecting Mat.

As near as can be gathered from the annual reports of the Mississippi River Commission, the dikes here shown were intended to close the Bullerton Chute and to confine the water in crossing the Bullerton Bar. In June, 1885, a main and six cross-dikes, aggregating 15,000 ft. in length, were practically completed at a cost of $24.72 per linear foot. This work was completed in October and November of 1884, and in January, 1885, surveys showed that the fill within the dike averaged 15 ft.

The Gold Dust system of dikes, on the same division, practically completed in October, 1884, was similar in appearance to those illustrated. The system was made up of one main dike, two miles long, and 7 cross dikes connecting this with the Tennessee shore. The older portion of these dikes was built of cottonwood, and after standing two years, it was found that the riders and braces had greatly deteriorated in strength by dry-rot and repairs were necessary.

Figs. 5, 6 refer to protection work done by Capt. LEACH at Memphis Harbor to stop serious encroachment, by a rapidly caving river bank, upon extensive tracts of valuable land already in part occupied by warehouses, elevators, cotton compresers, etc. Prior to 1878 this Memphis water front was comparatively stable; but in 1876 the bank had receded 350 ft. and was continuing to cave at the rate of 100 ft. per year. In 1877 surveys were ordered, and the engineer officer in charge was directed to report plans for protection.

The plan submitted proposed to revet the bank with willow mattresses ballasted with stone. Each mattress was 130 ft. long, 55 ft. wide, and 2½ ft. thick, and these were built in a suitable place, floated to the site and sunk side by side. The upper end of each was located at about low-water line and covered 55 ft. of bank and extended out 130 ft. From low-water line to a stage 10 ft. above low-water, the bank was to be covered with a layer of brush and stone. Revetment work was then in its earliest stage of development on the Mississippi, and although this plan was a decided advance on previous methods, it possessed several serious defects, and after the first season's work, in 1878, signs of weakness appeared and caving commenced.

Connecting Mat ready for Launching.

In 1882 this work passed under control of the Mississippi River Commission, and repairs were ta once ordered, and the original plan was modified by

extending the upper bank protection to high-water. But these repairs only postponed the danger. In July, 1884, an appropriation of $200,000 enabled the old plans to be abandoned, and later and more successful methods, as developed at other points in the meantime, were adopted.

The new plan contemplated the protection of the

View of Completed Revetment. River about Mid-Stage.

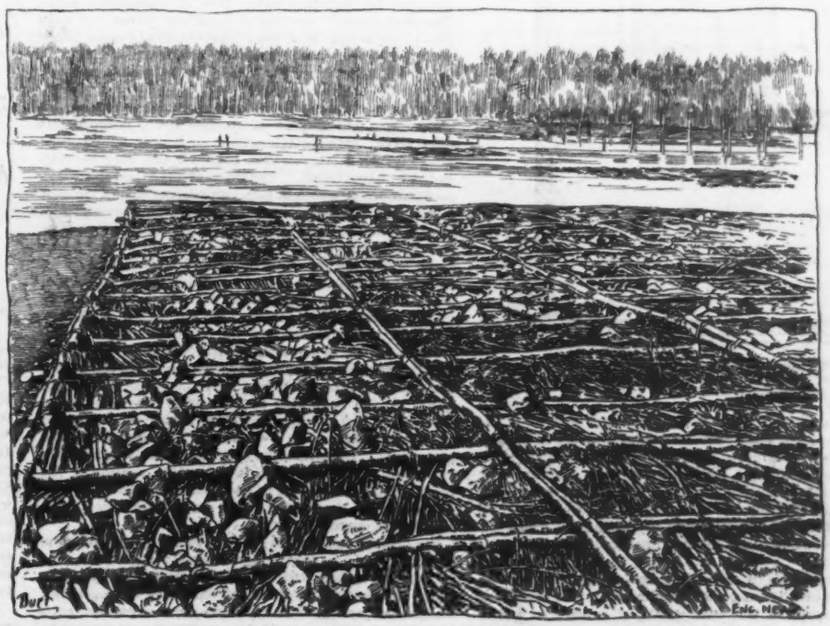
bank by a continuous revetment, 7,700 ft. long, and the subaqueous mattress was extended out 150 to 300 ft. from low-water, instead of 125 to 130 ft. as before. Increased stability was obtained by carrying a continuous longitudinal bond through the mattress, so that any part receiving too great strain could transfer the excess to adjacent parts above and below, and avoid the destruction of the work by successive attacks upon isolated pieces Economy in construction resulted from a decrease in the thickness of the brushwork. Operation on the new plan were commenced in July, 1884, and in September, 1887, the last mat was laid. The work has remained since in a perfect condition, without the loss of a foot of earth behind the revetment. The total cost of this work was $239,651.35, or about $30 per linear foot of bank. Capt. LEACH says, however, that this cost will much exceed that of similar future work, owing to unusual conditions of work. Taking the last 3,000 ft. of dike as a basis of estimate, it is shown that the actual cost was less than $12 per lineal foot of bank. For complete work, it was found both here and elsewhere that a subequeous mat 150 ft. wide represented 50 per cent. of the total cost. The Memphis mats were 250 to 300 ft. wide; but assuming that the percentage is no more than for the narrower ones, the completed work should not cost more than $24 per foot. The Memphis mattress was the heaviest and most costly work of its kind ever put down.

Purification of Sewage and Contaminated Water by Electrolysis.

The electrical treatment of sewage, one of the latest adaptations of this seemingly universal agent to the uses of man, is properly attracting the attention of sanitary engineers interested in solving one of the most important questions of the day. The system of Mr. WILLIAM WEBSTER has already been described in this journal, but at the late meeting of the British Association he gave still further details of his method and results, and from this paper the following matter is abstracted:—

The fact that water is easily decomposed, provided the current of electricity is of sufficient intensity, and also that the effects produced are precisely in accordance with the chemical equivalents of the substances electrolyzed, is practically the explanation of the whole system; for the chemical changes that take place in sewage when it is electrolyzed depend chiefly on the well-known action of sodium, magnesium, and other chlorides (which are always present in sewage) when split up into their constituent parts. Thus we have at the positive pole chlorine and oxygen set free, and these elements are liberated in a nascent state, a condition in which they are intensely active, so that the organic matter in the sewage is rapidly oxidized into innocuous compounds. So rapid is this action that, provided the sewage contains a sufficiency of chlorides, it is possible to produce a disinfecting fluid from it consisting of oxides of chlorine.

As mine is an artificial action, I will take the two disinfectants which are formed in my process, iron oxides and chlorine. The first as a purveyor of oxygen, the second in the form of hypochlorite of chloric acid, absolutely destroys organic matter living or dead. By using non-oxidizable plates, such as carbon for positive pole and iron



View of Mat built Afloat, and afterwards exposed by Falling River.

at the negative pole, with a porous diaphragm between them, I am able to collect the component parts of the mineral salts; therefore at the non-oxidizable plate I obtain a solution of chlorine and oxide of chlorine, and at the negative plate I obtain ammonia, soda, and potash, which in their turn precipitate any lime and magnesium salts that may be present in the liquid. So strong is the action of oxide of chlorine that it is only one form of carbon plate that will resist disintegration.

My first experiments carried out in this manner were conducted with platinum plates, but the experience was that the cost of platinum put it out of the question, besides which there was a very slight action on the positive plate which distinctly pointed to its ultimate destruction, there being no precipitation in the sewage of matters in suspension. By means of an arrangement which consists of a porous pot with a non-oxidizable plate—such as carbon for the positive electrode and iron plates for the negative electrodes—I am able to manufacture the beforementioned solution of oxides of chlorine from brackish sea-water or sewage. The water of the River Thames near Barking is admirably suited for this purpose. It is possible that an objection may be raised that the resistance of the porous pot to the electric current would be so great that the cost would render it an impossibility from a commercial point of view, but the very fact of using salt water balances the extra resistance caused by the porous diaphragm, and for every ampere of current that is used per hour I produce 18 grains of nascent chlorine, or an equivalent of the oxides of chlorine. My experience of nascent chlorine as a disinfectant is that about one-third of a grain is capable of disinfecting one gallon of London sewage (first removing the matters in suspension) and on examination the presence of nitrites is detected, which shows how far the oxidation has been carried. This action, combined with the treatment with iron plates, hereafter described, will, if carried far enough, absolutely eradicate all organic matter. And here it will be as well to mention that the resulting effluent must not have an acid reaction, otherwise fungoid growths appear on the surface after a few hours. The forms in which these apparatus are best applied on a small scale, with porous diapragms, are as follows: First, an outer vessel, which may be made of iron—the sides in that case acting as negative electrodes—and an inner vessel containing the carbon electrode. By means of a syphon connected with a reservoir or tank, containing, say, sea-water or salt and water, the inner vessel can always be kept supplied with the saline solution, and by an easy automatic arrangement it is possible to draw off a given quantity of disinfectant solution when formed. By placing an oxidizable plate in the same pot as the carbon, and connecting the two to the positive pole of the current, I can produce a hypochlorite or chloride of the metal used which will thus further assist the resulting action. The many uses to which these disinfectants can be applied I need not enlarge upon. Six small cells of the latest form of the Leclanche type are quite sufficient for producing the necessary power for making two or three gallons of the chlorite solution during the day, and they will last for several months without recharging, it being understood, of course, that they do not remain continuously in action. The apparatus on a large scale may be variously modified acording to the strength of the solutions of chlorides acted upon.

By applying the current to a carbon filter, I am able to oxidize the organic matter in water. The positive pole being the porous carbon block, the nascent oxygen produced in the pores of the carbon by the electric current absolutely destroys the organic matter; bacteria being killed and the filter-block itself kept clean. The action of porous carbon by itself is due to its power of absorbing noxious gases and effecting their destruction by bringing them into contact with atmospheric oxygen, but it is absolutely essential that there should be a free supply of air; how much more active the action is when nascent oxygen, and even chlorine, are constantly supplied to the

pores of the carbon by means of the electric current, can be easily imagined. As an example, the following analysis before and after action may be of interest:

FILTER EXPERIMENT ANALYSIS.
Parts per Gallon.

	Appearance	Odor	Oxygen required to oxidize the organic matter.
Before action—Dilute sewage	turbid	bad	0.93
After action—Nitrates present	clear	none	.17
Before action—Contaminated water	slightly turbid	slight	.06
Before action—Contaminated water	clear	none	.00
After action—Dilute sewage	turbid	bad	0.82
After action—Ordinary carbon filter	slightly turbid	slight	0.4
After action—Electric carbon filter	clear	none	0.13

Current used, 0.5 ampere.

For the purpose of this filter, an ordinary form of stoneware, divided so that the lower compartment contains rather more than the upper, is used. A carbon block is fixed in the usual position, and round this block two pieces of asbestos twine are tied. At the top of the block a platinized screw terminal is fixed. This forms the positive electrode. For the negative electrode, carbon rods are arranged so that they press on the asbestos twine. They are all connected together by means of a carbon disc at the top, also provided with a screw terminal, or, instead of the rods, a carbon cylinder may be used. All that is required is to attach these terminals to the respective terminal of a battery, consisting of three Leclanche cells, arranged in series. The action is automatic, as when the top compartment is full the battery is in action, when empty it is at rest.

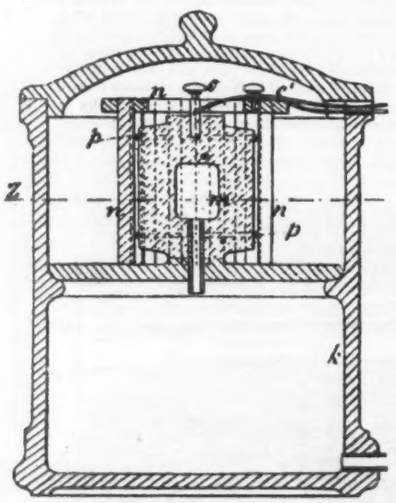


Fig. 1.—Filter. *c c'* show wires to battery; *m* positive electrodes; *n n* negative electrodes; *p p* non-conducting strips; *k* containing vessel.

On a large scale I have the filter arranged as follows: Alternate layers of small coke free from sulphur are separated, either by layers of sand or perforated tiles; by suitable connection these beds of coke form positive and negative electrodes, the first layer of material being sand so as to mechanically separate matters in suspension. It is impossible for disease germs to propagate, owing to the nascent oxygen and chloride produced when the filter is in action.

Another form is by embedding non-oxidizable plates in sand, with or without porous diaphragms. The necessary electric current in this case would, of course, be taken from a dynamo. For the treatment of sewage it is absolutely necessary that precipitation of the matters in suspension should take place, and the more complete this is, the better the ultimate result.

To produce this, I employ oxidizable plates of such material that they shall have no poisonous after-effects either on land or in rivers. The metals should be either aluminium or iron, but the first-named is out of the question owing to cost, and then iron, besides having the advantage as regards price, in the form of oxide has many valuable qualities, one of the chief being that sulphuretted hydrogen cannot exist when ferrous or ferric oxides are present. It is well known that oxide of iron in the hydrated form is largely used for purifying coal gas from sulphuretted hydrogen.

The electric action is easily explained practically. At the positive pole the chlorine and oxygen given off combine with the iron to form a salt, which I am persuaded is for the moment a hypochlorite of the metal, but it immediately changes into a chloride, which in its turn is deprived of chloride to form ferrous carbonates and oxides. During the chemical action carbonate of iron exists in solution, and its formation is due to the presence of carbonates in the sewage, chiefly carbonate of ammonia. In

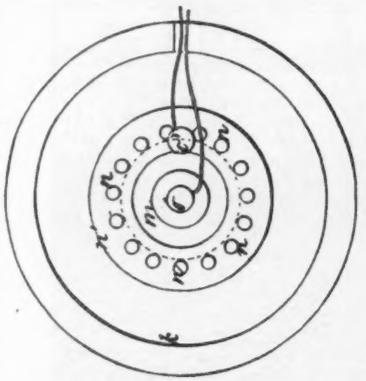


Fig. 2.—Section on Line *Z Z*.

samples that are absolutely free from dissolved oxygen, the ferrous oxide in the white form is precipitated, and on shaking up with air it changes to the usual pale green color. The carbonate of iron at the same time being oxidized, the ultimate precipitate is red, known as ferric oxide ($Fe_2 O_3$), and I have noticed that sometimes this changes, after a time, back again to the ferrous state (Fe O), thus showing that it has acted as a carrier of oxygen to the organic matter present. On a small scale the precipitate is carried to the top, due to the bubbles of hydrogen collecting round the particles of matter in suspension, but it ultimately sinks in the usual manner. In practice the precipitate does not rise, owing to the larger evaporating area, which allows the escape of the gases produced. The current required for the action varies with the nature of the sewage; but in this case I am using an ampere of current, and the amount of sewage is one-eighth of a gallon. It is usually assumed that 1.5 volts are required for splitting water into its component parts. This may possibly be true with carbon plates, but with iron plates acting on sewage I can obtain the same result with 9 volts as with double the intensity; of course, it takes a longer time, for with such a low voltage the quantity of current is small.

An ordinary sample of sewage requires, per gallon, on an average, one ampere of current for 10 minutes, but when mixed with foreign matter, such as manufacturers' waste products, the amount required can only be estimated by experiment. The small plates I used in the experiment are of wrought iron; on a larger scale I use cast iron of the commonest "pig" quality, which is only one-third the cost and has the virtue of not scaling. Most of my experiments have been carried out with wrought-iron sheet, which has the disadvantage of scaling, but on account of its lightness is more suitable for experimental work. The plates themselves should always be kept under water so as to prevent the formation of the red oxide on the surfaces, and the action should be continuous as far as possible, for if continuous the plates seem to acquire some property which reduces the resistance to the electric current and therefore lessens the cost. At the beginning of a month's run which lately took place, the voltage measured across certain plates was 3, but after a few days only 1.79, and doing the same work. On examining the plates freshly taken from the liquid they were in, I found a thin coating of the black or magnetic oxide of iron, which has the property of preventing the rusting of the plate under water when the electric current is cut off.

For 1,000,000 galls. sewage flow in 24 hours, the complete plant necessary is: engine, dynamo and boiler-house; two engines and boilers, each 12 H. P. nominal; two dynamos, brick shoots with culverts at side, two setting-tanks, sludge-tank, sewage culvert, treated sewage culvert, cast-iron plates, copper conductor, measuring instruments. Where the effluent has to run into a small stream or river, a suitable tank would have to be constructed for arranging the electric filter, as before described.

A channel is kept at the bottom of the electrodes for the silt to collect, with a culvert at side to flush it into so as to prevent any block occurring, but the advantage of this is obvious. The plates in each section are about an inch thick, and can be of any length up to 6 ft.; it may possibly be objected that a large number of plates is required. This may be so, but the larger the number of plates the less the engine power required, and the longer they last. In each section the electrodes are in parallel, and any one section is in series with the other, the arrangement being exactly like that of a series of primary battery cells.

By actual experience I have been able to prove that at least 25 sections of electrodes should be in series, and across any one of these sections the potential difference need not be greater than 1.8 volts, the current being of any desired amount according to the surface of plates used. In experiments that were lately carried out I used a current of 370 amperes, which was calculated as .23 ampere per gall. per hour; or taking it in watts, the estimated horse-power required per million gallons in 20 hours was 23. The organic matter in solution of the particular sewage acted on on this occasion showed a reduction of 61 per cent. after treatment. The plates, even at half an inch apart, show no signs of blocking; the liquid to be acted on of course should be screened in the usual way, and allowed to run through the plates as rapidly as the treatment required will allow, so that every molecule shall come into contact with the surfaces of metal. During a run that lately took place the measurement across the electrodes proved that 19 estimated horse-power was required to treat 1,000,000 galls. in 24 hours, the resulting purification of organic matter in solution amounting to an average of 50 per cent., the waste of the iron plates showing an average of two grains per gallon of sewage treated.

In putting down plates for the above quantity of sewage I should allow sufficient weight for five or ten years' consumption; what remained of this could be sold as "old iron" at the end of that time. One of the advantages of having the plates in series is that if anything goes wrong in any particular section it can easily be set right, the current being cut off during the repairs. The shoot containing the electrodes should be coated inside with some sort of asphalt, so as to prevent, as far as possible, any leakage of current to earth, the asphalt acting as a sort of insulator. The highest efficiency would be obtained by using direct driving, provided that the engine is of first-rate workmanship, and the dynamo constructed to run at a comparatively low speed. This saves in transmission, and prevents any difficulty that might arise with belting. The consumption of coal under the best conditions may be taken to range from 1.8 to 2.5 lb. per H. P. hour; the cost of fuel and iron varies so much in different districts—prices in London being nearly double those near mining localities—that I leave the question of an accurate estimate open; discounting this, it may be taken that the capital outlay necessary for complete plant, and capable of dealing with the sewage of a small town, amounting to a flow of 1,000,000 galls. daily, would be about £6,000 or £7,000, the engines and dynamos being in duplicate, as, I presume, most engineers would agree they should be. The quantity of iron plates included in the above sum would be serviceable for 10 years as far as one can foresee, and I am also assuming that the town where this plant would be erected has no appliances for treatment such as precipitating-tanks etc.; where these are already in existence the cost would naturally be less. In reference to the cost per million gallons, the same arguments hold good as to the situation of the town ruling the price, since the rise in the markets has increased the cost of working; but it can be arrived at by the average consumption of iron and the necessary horse-power. Thus the daily waste of iron may be taken as 286 lbs., and the consumption of coal three-fifths of a ton. The labor required for working a plant of this description would be two shifts two men to each shift.

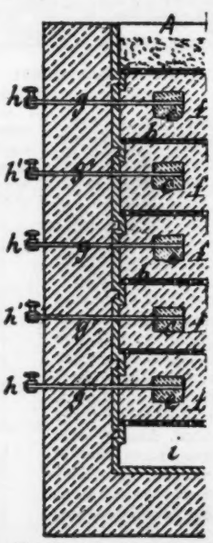


Fig. 3.—*f f'* coke filters; *b b* partitions; *g g'* insulated conductors; *h h'* terminals; *c c* carbon eltrodes: *i* effluent.

By combining the treatment of sewage-flowing between metal plates with the electric filter, it is possible to produce any degree of purity required. In this case the sewage, after action with the iron electrodes, is allowed to flow into a settling-tank, and after remaining there for an hour for the precipitate to subside, the effluent is passed through the filter, any oxide of iron that may be present tending to keep the top layer of filtering medium free from any objectionable action, and in turn forming a filtering medium. As the filter consumes no material, and does not require any additional engine power, in using it the electrolytic action with metal plates not being carried so far, the cost of working need not be considered. When a sufficient amount of oxide is deposited on the top layer of sand, it can be removed, allowed to dry, and sold to gas works. The resulting sludge contains 16 per cent. of iron oxide, which does not represent the waste of the plates alone, for, in London sewage, the wear

and tear of the tires of wheels, horses' shoes, etc., in the streets means oxide of iron in its composition. One sample taken some months back contained no less than six grains iron oxide in the gallon before treatment.

The author of the paper concluded by quoti n from analyses made by Sir HENRY ROSCOE during an investigation of the process. The quantity of sewage operated upon was 20,000 galls. Sir HENRY says: "I have not observed in any of the unfiltered effluents, from this process, any signs of putrefaction, but, on the contrary, a tendency to oxidize. The absence of sulphuretted hydrogen in samples of unfiltered effluents, which have been kept in stoppered bottles for three weeks, is also a fact of importance. The settled sewage was not in this condition, as it rapidly underwent decomposition in two or three days." The analysis of Sir HENRY ROSCOE was as follows:

No.	Percentage of reduction of oxygen required to oxidize organic matter.	Albuminoid ammonia.
1	67.4	57.0
2	64.3	57.3
3	77.2	75.0
4	72.6	50.0
5	76.5	87.5
6	73.0	87.5

Mr. WEBSTER further shows that in another series of experiments by Sir HENRY ROSCOE, there was an average reduction of 60 per cent., although the full treatment was not carried out. He thinks that the bacteria question, in connection with electrical treatment, has yet to be settled. But Paris experiments with ordinary iron electrodes gave results as follows:

Organisms per cu. centimetre in raw sewage 5,000,000
" " " in effluent... 600.

A Steam Engine with Combined Piston and Slide-Valve.

We illustrate herewith a novel form of steam engine which has been in use for some time in Germany and is now being introduced into the United States. The novel feature of these engines is the absence of all the usual paraphernalia of eccentrics, rods, links, rockers, steam chests, and slide valves. The piston, by a novel method of construction, is adapted to act as its own perfectly balanced valve in admitting and exhausting the steam to and from the cylinder.

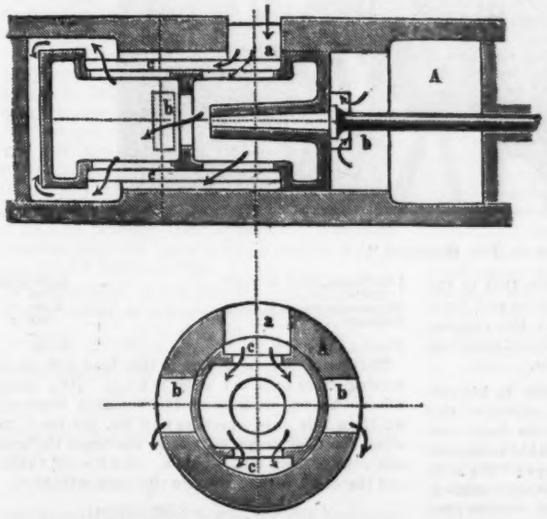


Fig. 1. A Combined Piston and Slide-Valve Engine. Sectional Views.

The construction of the piston and cylinder is plainly shown by the sectional views in Fig. 1. As may be seen, the piston is hollow, and is kept constantly filled with steam at boiler pressure through the passage *a*, which is always open. The exhaust ports are shown at *b*, one on each side of the cylinder. In this engraving the piston is shown at the left-hand end of the cylinder, with the admission ports wide open to supply that end with steam, and the exhaust port from the other end at *A* also fully open. Suppose the piston now to start toward the right, and remember that from the nature of its motion its velocity is slowest at the extreme ends and most rapid at the center of its travel. Soon after its start, the exhaust port *b* is closed, and compression of the steam in the right-hand chamber *A* begins. Next the live steam is shut off from the left-hand end of the cylinder, leaving it to work expansively. As the piston reaches the last quarter of its stroke, the live steam port opens to the right-hand end, admitting live steam for cushioning; and with a slight further advance, the exhaust port from the left end is opened.

It will be readily seen that this engine begins its stroke with the full boiler pressure at one end, no back pressure on the other, and the admission and exhaust ports both wide open. The opening and closing of both the steam and exhaust ports takes place when the piston is at some distance from the end of its stroke and is moving with such velocity as to avoid any throttling of the flow of steam. Compression and pre-admission of live steam are so well provided for as to fully absorb the momentum of the piston. As the live steam passage is open for a considerable time before and after the end of the stroke, compression cannot raise the pressure above that of the boiler. The compressed steam is furthermore so mixed with live steam before the end of the stroke is reached as to prevent the condensation which is apt to take place under high compression. Another point of excellence is that the hollow piston forms at once a steam reservoir and an "internal steam jacket," thus tending still more to prevent condensation. The clearance space also, including the volume of the steam passages, is less, probably, than that of any other engine in existence. To show the action of the piston as a valve more clearly, we give in Fig. 2 a sample indicator diagram.

Of course, the point of cut-off is fixed for each engine at its construction, and is not changeable; theretore the speed of the engine has to be regulated by a throttle governor. The engine, therefore, is not intended to compete with the large sizes of engines with variable cut-off valve motion; but for engines as large as 50 to 75 H. P. its makers claim that it is superior in many respects to any engine on the market. One of these engines, tested by R. SCHOETTLER, Professor at the Brunswick Technical School, showed in a run of 2¾ hours an average of 8¾ brake H. P. and a consumption of about 51 lbs. of steam of about 100 lbs. pressure per H. P. hour. The engine piston was 150 mm. (5.9 ins.) in both diameter and stroke. The revolutions were 623 per minute. A horizontal engine of this size weighs about 1,650 lbs., and occupies a floor space of about 5 ft. x 3 ft.

It is claimed that these engines can be built cheaper than the ordinary type of throttling engine, since the whole expense of the valve motion is saved. They are built either single or double, horizontal or vertical, and will also be built as compound engines if desired.

The invention of this ingenious motor is certainly a triumph in mechanical design. Who could have prophesied, in the days when the valves of the steam engine were moved back and forth by a tired boy, that the piston which furnished the power would finally be so formed as to open and shut the steam ports of the cylinder without the help of any auxiliary mechanism?

It is to be noted, however, that there are some defects in this machine as compared with the ordinary type of throttling slide-valve engine. It will probably require some experiment to determine how serious they are. It will be noticed, of course, that the piston face is solid, and that it must therefore be very carefully fitted. The cylinder, we should judge, would require unusual care in boring. If this work is carefully done, and if the engine is kept well lubricated, the engine will probably run a long time before leakage begins to be manifest. But sooner or later, in spite of the large bearing surface, some wear will be manifest; and as this increases, leakage of steam and corresponding loss of economy will grow more serious. This will be especially the case with horizontal engines, where the weight of the piston has to be carried on the lower half of the cylinder. To make the engine a long-lived one, it seems probable that some arrangement of removable rings will have to be adopted for the wearing face of the piston, so that the cylinder can

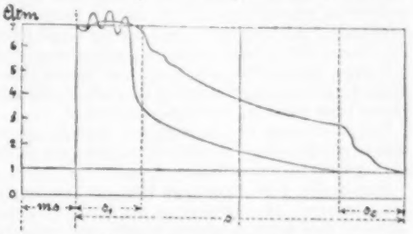


Fig. 2. Indicator Diagram from Grabner Engine.
Scale $\frac{1}{10}$ full size.
s = stroke of piston; s_1, = distance travelled before steam is cut off; $s\,c$ = distance travelled by piston with the exhaust open.

be re-bored when necessary, and a new ring placed on the piston; or the whole piston could be renewed at no great expense.

The inventor of this engine is Herr GRABNER, General Manager of the works of K. & Th. Möller, at Kupferhammer, near Brackwede, Westphalia. The invention is covered by United States and foreign patents. It is being introduced in this country by Mr. JOSEF ZERVAS, 570 Park Ave., New York

Pin-Connected vs. Riveted Bridges.

At a meeting of the Society of Engineers, at London, Oct. 7, Mr. H. ADAMS, Vice-President, in the chair, a paper was read by Mr. J. H. CUNNINGHAM, M. Am. Soc. C. E., on "Pin-Connected vs. Riveted Bridges."

The author stated that toward the end of the year 1884 he had made two designs for the superstructure of a bridge to carry a railway across the Mary River in Queensland. There were to be three spans, the center one being 120 ft. long, and those at the sides each 80 ft. in length. In the one design pin-connected trusses having long panels, such as are now common in America, were adopted, and in the other the trusses were of the lattice type, and all their joints were riveted. The pin-connected design was prepared as an alternative in order to ascertain whether a structure of that kind would be cheaper than the riveted one. On carefully comparing them, it was found that the pin-connected trusses were 19 per cent. lighter than the riveted ones, and that in erecting the work in the field, 5¼ rivets would have to be driven in the riveted structure for every one required in the other. But these advantages were partly counterbalanced by the greater weight of the floor in the pin-connected bridge, and the riveted one was selected and built.

The author then proceeded to apply the facts above noted to bridges in general. He thought they indicated that pin-connected bridges would be more economical and more easily erected than riveted ones, and American experience fully confirms these conclusions. In the States, the economy of every type of bridge had been thoroughly tested by rival builders, and they had found that the best results were obtained by using long panels with pin joints. Bridges of that kind were erected very quickly, spans of 400 to 500 ft. being put together in from four to six days, and 250 ft. spans in two days.

In concluding, the author drew attention to the importance of adopting improvements in bridge building. English engineers were fully alive to this, and he would merely suggest that progress was more likely to be made by greater care in designing, and more extended use of machine tools in constructing, than by the invention of new types of trusses. He thought that those who tried to effect improvements on these lines would find their work simplified by using long panels and pin-joints.

IRRIGATION IN THE SOUTH is being advocated by some of the Southern newspapers and agricultural journals, especially in southern Alabama and in Florida. Recently the *Florida Agriculturalist* devoted an issue to this subject. It is urged that irrigation would insure the farmers and fruit-growers against failures of crops and fruits in unusually dry seasons, and would also fertilize the land.

The "Chemin de Fer Glissant," or Sliding Railway.

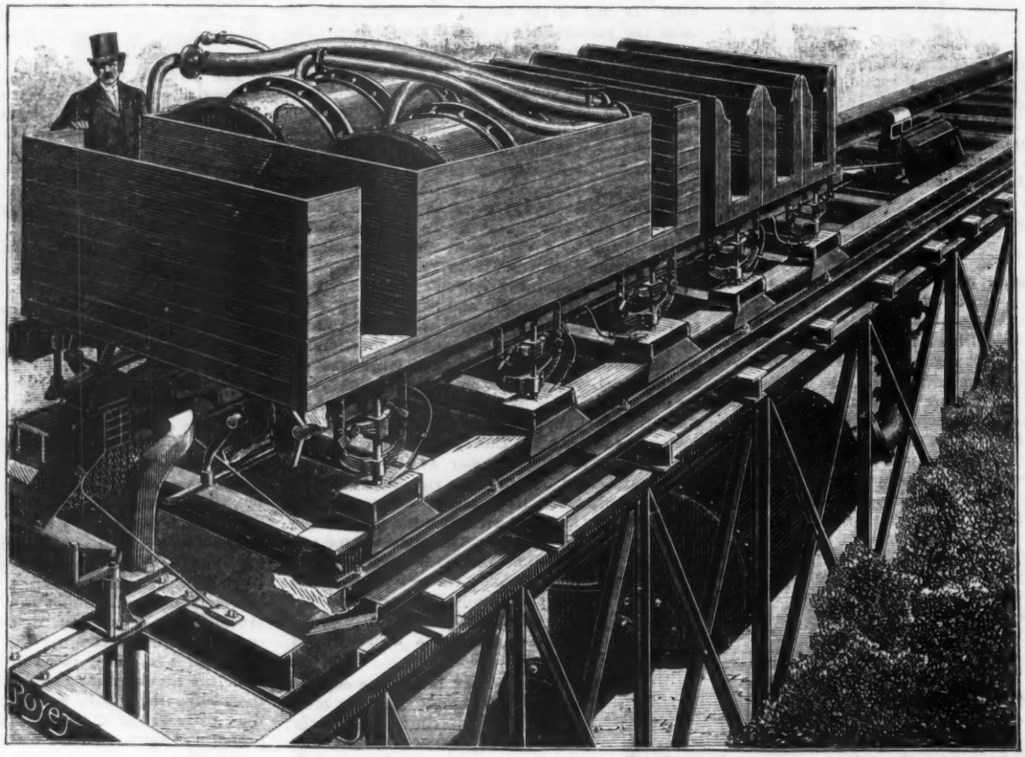
In our issue of Aug. 31, a Paris correspondent gave to our readers sketches and an excellent general account of this novel and promising method of propulsion on railways now in operation in Paris. We supplement this article by some further detail from *Le Génie Civil* of Sept. 28, and reproduce from that journal a perspective view which will better illustrate the general appearance of this new hydraulic motor than anything we have given before.

The description of the operation already given was so complete that we will only supplement it by giving some further collateral data.

Among the first objections that are naturally made against the method of M. GIRARD is the effect of cold upon a system which rests entirely upon the use of water. M. BARRE, the engineer, answers this objection as follows: As all the liquid used in the various parts of the machine is carefully gathered again for re-use, it is believed that a regular service can be maintained in the climate of France by a mixture of water with one-fifth part of glycerine. Even admitting that the total loss would reach 1 per cent., the loss of glycerine would only be 0.2 per cent. In place of glycerine the chloride of magnesium may be used; the latter is cheaper than glycerine and does not attack metal. A proportion of 1 of chloride to 7 of water would be sufficient.

If it is preferred to use the water alone, it would be necessary then to protect, by non-conducting covering, the accumulators and *propulseurs*, or motor jets. In the case of an elevated metallic roadway these parts could be covered by wooden casing placed between the girders. The reservoirs for the pumps could be arranged in such a manner as to be heated in winter. With a temperature of 5° Fahr., for example, it would only be necessary to raise the water to 61° Fahr. to permit the whole apparatus to lie idle for 20 hours before the temperature would fall to 32°. The thin sheet of ice which would form on the sides of the "rail," as it may be called, would be melted, and removed by the water of the following train. The only precaution necessary would be to detach the *patins*, or slides, from contact with the rail after a long stop by circulating through them for a few seconds a jet of steam before moving, from the heating apparatus of the cars or otherwise. In the case of a line located upon the ground, the apparatus of propulsion would be enclosed in a gallery placed either under the road or at the sides.

As the movement of trains thus propelled is extremely easy and produces no shock, it is alleged that the roadway may be placed directly on the ground without any kind of ballast. [We doubt this.—ED.] This feature, coupled with the ability to ascend steep grades and pass around curves of short radius, enables the engineer to practically follow the natural surface and to make the actual construction very economical. The speed of these trains is very considerable. There is no economical purpose in reducing it for certain classes of traffic. In the case of curves, the friction is no greater than on a straight line, for the trains reach the curves always with the same velocity, and the rails can be so inclined as to entirely destroy the centrifugal force,—a result which cannot be reached in a combination of rails and wheels.



Perspective View of the "Chemin de Fer Glissant."

The important claim is justly made that in the cases of water power of great volume and force found so often in mountain regions, the expense of traction will be little more than that of selecting and leading this power to the machine.

It is interesting to follow M. BARRE in his calculations relative to the propulsive efforts of the motors, with a given acceleration to the train, and the gradient which the train will be able to ascend with a given velocity. M. BARRE says: "We will suppose a train to be descending from a station by its own weight and that it arrives at the first *propulseur* with a speed of 4 m. per sec. (8.8 miles per hour) for example. We will admit that the *propulseur* forces the water-jet under an effective pressure of 10 kilos. per sq. centimetre (142.2 lbs. per sq. in.), or that due to a head of 100 m., and that the area of the issuing jet is 28 sq. centimeters (4.32 sq. ins.) Each *propelseur* would then have, per second, a delivery of

$$Q = 0.85 \times 0.0028 \times \sqrt{2g \times 100} = 105.4 \text{ litres};$$

taking 0.85 as the practical coefficient of efflux.

If the rectilinear turbine of the train, and as a result the train itself, moves with a velocity of 22 m. per sec. (48 miles per hour), which is equal to half the velocity of efflux of the jet under a pressure of 10 kilos, this turbine will then utilize, according to the rule with ordinary circular turbines, 70 per cent. of the force expended. The *propulseur* would thus have a useful effect of

$$F = 105.4 \times 100 \times 0.70 = 7378 \text{ kilos.},$$

and the effort of propulsion exerted upon the train would be

$$E = \frac{7378}{22} = 335 \text{ kilos., about.}$$

But as the train only moves in reality with a velocity of 4 m., it is proper to multiply this effort as found by a certain coefficient, that is determined by a diagram of the path of the floats of the turbine, which coefficient is valued at 1.35. This coefficient diminishes as the speed of the train increases.

The first *propulseur* would then exercise in reality upon the train a propulsive effort of

$$E = 335\,k. \times 1.35 = 452.20 \text{ kilos.},$$

or in round numbers 450 kilos.

If we now suppose a train of four carriages and a tender, with 120 passengers, the total weight would be distributed as follows:

4 carriages, 2,500 k. each	10,000 kilos
1 tender	7,000 "
120 passengers, 70 k. each	8,400 "
Baggage	800 "
Total	26,200 "

The resistance to sliding in this load will be on leaving, 26.20 tons × 1 = 26.20 kilos. [We judge this to be an estimate of the "rolling friction," which in this case amounts to 2 lbs. per ton.] So after the first *propulseur* is in operation the total accelerative force will be: 450 *k* — 26.2 *k* = 423.8 kilos. and the acceleration given to the train will be:

$$J = 0.81 \times \frac{423.83}{26.20} = 0.1586 \text{ metres};$$

or say 0.159 m. per second.

The train being about 35 m. long in the case considered will always be in contact with a *propulseur*, if these last are placed 35 m. apart, and the speed of 22 m. will be reached at the end of 113.20 seconds; since

$$0.159 \times 113.20\,s. = 18 \text{ metres}$$

and

$$18\,m. + 4\,m. = 22 \text{ metres}.$$

With *propulseurs* placed 35 m. apart the train in question would be able to ascend a grade of 1.617 per cent., since,

$$26.2 \text{ tons} \times 16.17\,k. = 423.8 \text{ kilos.}$$

But in this case the accelerative force becomes zero; that is to say, the train will only preserve during its ascent the velocity that it had on reaching the foot of the grade.

[A clearer way of putting this, perhaps, is that, as there is a constant propelling force of 424 kilos to move 26,200 kilos, it is able to move it up a $\frac{424}{26200} = 1.62$ per cent. grade. If that grade exists, the train will continue up it at uniform velocity. If there be no grade, but a level, the added force will take the form of velocity, which at every point will be equal to that due to a "velocity head" equal to the height that a 1.62 per cent. grade would have raised the train in that distance had it existed, i. e., as per table of Velocity Heads on page 335 of the "Economic Theory of the Location of Railways."*

* This table is slightly inaccurate for this particular use, in that it is computed to include the rotative energy of the wheels, which adds some 6.14 per cent. to the energy due to the linear velocity. The *chemin de fer glissant* has no wheels. In the following note on brakes this error is eliminated.

In a distance of	Lift of 1.62 p. c. grade =	Same + vel. head due to initial vel. of 8.8 m. per h.	Corresp. speed in miles per h.
1,000 ft.	16.2 ft.	18.9 ft.	23.1
2,000 "	32.4 "	35.1 "	31.4
3,000 "	48.6 "	51.3 "	38.0
4,000 "	64.8 "	67.5 "	43.6
5,000 "	81.0 "	83.7 "	48.6

If there be a lower grade, only a part of this energy will take the form of velocity, but the process of computation will be the same.—ED. ENG. NEWS.]

If we now suppose that the *propulseurs* used have a double section of orifice, or 56 sq. centimeters, the pushing force exerted upon a train moving with a speed of 4 m. per second, would be:

$$(450\text{ k} - 26.2\text{ k.}) + 2 = 847.6\text{ kilos.};$$

and with intervals of 35m. between the *propulseurs* a grade of 3.225 per cent. could be ascended, since

$$26.2\text{t} \times 32.35 = 847.6\text{ kilos.}$$

If orifices 56 centimetres square are placed every 7 m. there would always be five *propulseurs* exerting at one time a pushing force upon the train, and the total effect would be:

$$847.6\text{ k.} \times 5 = 423.8\text{ kilos.}$$

Such a train could ascend a grade of 16.17 per cent, or 1 in 6 and still maintain the velocity of approach to the foot of the grade, since;

$$26.2\text{ tons} \times 161.7\text{ kilos} - 423.8\text{ kilos.}$$

And finally, by simply increasing the jet section and that of the turbines and by a proper spacing of the *propulseurs*, any grade may be ascended with a given speed.

To stop the train, it is only necessary to cut off the water from the sliding shoes, and the weight of the train and the friction upon the rail will bring about the desired result according to the following figures of M. BARRE:

If we suppose the train of 26,200 kilos. to be moving at the rate of 22 m. per second (49.1 miles per hour), and that it becomes necessary to stop this train as quickly as the system will permit, to do this we will suddenly shut off the flow of water between the shoes and the rails. The shoes will then rest upon the rails and their friction will determine a retarding force the value of which will be, according to what is before shown:

$$E = 26{,}200\text{ kilos.} \times 0.52\text{ per cent.} = 13{,}624\text{ kilos.}$$

and the retardation acting to stop the train will be:

$$J = 9.81 \times \frac{13624}{26200} = 5.10\text{ metres;}$$

and the speed of 22 m. will be destroyed in

$$\frac{22}{5.1} = 4.31\text{ seconds.}$$

During this time the train will have passed over a space of

$$E = 22 \times 4.31 - \frac{5.1}{2} \times 4.31^2 = 47.46\text{ m. (155. 7ft.)}$$

[We do not know where M. BARRE gets any right to assume so great a retarding coefficient of friction as 0.52, and the method of computation is otherwise cumbrous. Regardless of the particular weight of the train, all of which is on the *patins*, its velocity-head, moving at 49.1 miles per hour, is by the table above referred to 80.6 ft. If, then, the coefficient of friction be 0.5, it will stop in just twice that distance, or 161.2 ft. If 0.52, it will stop in $\frac{80.6}{0.52} =$ 155 ft. as computed. If 0.25, which is the far more likely valve, and the highest ever realized with brakes, in 322.4 ft., in any case a marvelously good stop, this being one of the neatest and best features of the system.—ED. ENG. NEWS].

This exceedingly rapid stop will be made without shock. On the other hand, a proper manipulation of the valve admitting water to the shoes will enable the operator to stop the train as slowly as he pleases.

The advantages of the system are summed up by M. BARRE as follows: (1) Ease of motion; no shaking and no lateral movement. (2) No noise, dust, or smoke. (3) Derailment impossible, as no foreign body can get under the shoes. (4) An almost instantaneous stop without shock; as a consequence collisions may be easily avoided. (5) Ease in ascending steep grades and passing around curves of short radii. (6) A velocity touching 124 miles per hour, with a pressure of 22 kilos. (313 lbs. per sq. in.) in the supplying conduit. (7) Lightness of material in roadway, and consequently economy in construction. (8) Considerable economy in the expense of traction and in the weight and cost of carriages. (9) Notable economy in repairs in the motive power. M. BARRE estimates this latter item as being equal to 66 per cent., on account of the reduction in the number of horse power necessary to operate this machine, and because proper pumps for compressing water move slowly and are not subject to the excessive shaking and speed of moving parts incident to a locomotive in operation.

M. BARRE claims that the obstacles to the system are included in the expense of the first plant, the providing of considerable quaptities of water, the action of cold, etc.; not counting the obstacles as yet unforeseen which may arise in practice. He claims that it is as easy to provide for the proper supply of water to each shoe in use as it is to be assured of the proper behavior of each wheel under an ordinary railway train.

An Electric Railway Signal.

The following description relates to an ingenious electric railway signalling apparatus that has well stood the test of service, and is now in use on railways in New England and in other sections of the country.

The leading object of this invention is to provide an alarm having such capacity of continuance as is requisite at stations or at highway crossings on railroads to give warning of the approach of trains, and to be exempt from the inherent weakness and frequent failures of the ordinary electrical vibrating bell.

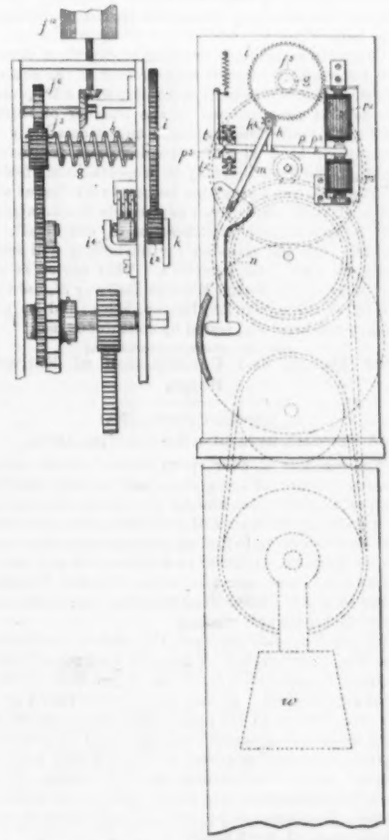
Its uses are: (1) As an independent cautionary signal, on crossings otherwise unguarded. (2) As an auxiliary safeguard, at any and all points, however otherwise in any degree protected; and also (3) As an ordinary "train annunciator"; affording the proper signal, more or less prolonged, to station agents or crossing keepers. It may also be put to service (4) As a single-stroke call or signal bell (in any position). It will, of course, be understood as controlled by a detent which can be operated electrically from any desired point.

The apparatus includes (see drawing) a heavy suspended weight, *w*, which operates through speed-increasing pulleys and wheel gearing, terminating in the loose pinion f^1, to maintain tension in a main spring *h*, coiled upon and impelling the arbor *g*, which again connects by its gear wheel *i* with a working pinion i^2. On the face of this pinion is set the detent arm *k*, engaged or disengaged according to position of armature lever *p*, pivoted at p^2; and the face of this detent arm carries a wristpin k^2, from which a link or pitman *m* extends obliquely downward, and gives an oscillating motion to the hammer stem *n*, whose normal position (at rest) is nearly vertical, with the hammer head barely clear of the gong, behind and within which its movement is executed.

Without the device of the suspended weight *w* operating as above described, the maximum number of blows that can be obtained from spring-impelled mechanism has been found in practice to be about 300; by its aid this can readily be worked up to 15,000, and more if required. Moreover, the spring as heretofore used gives blows that decrease in force (and also in frequency) as the spring unwinds; but by this provision we obtain complete equality of force and regularity of action throughout the entire series of blows, equivalent to two hours more or less of continuous ringing for each winding, the blows succeeding each other at intervals of about one-half second.

The motive force obtained by descent of the weight is substituted, with an effect much superior in certainty as well as in power, to the work of the local or "ringing circuit," with its battery and circuit-closers; for (apart from obvious gain in the substitution of mechanical for battery impulse in delivering the blow) it is evident that we eliminate points of acknowledged weakness and insecurity in dispensing with the circuit-closers forming essential parts of the local circuit working the ordinary bell. In the new bell, which may be styled a "mechanical vibrator," the line circuits are led directly to and through the helices of the magnets governing the detent.

If line circuit is normally open, the upper magnet r^3 is the one to be employed; when the current is in, the magnet withdraws the detent and the bell rings continuously; when the current ceases, the usual retractile spring (in such case supplied to the armature lever) replaces the detent and the ringing is stopped.



Internal Mechanism of the Electric Railway Signal.

Or, if desired, the bell may be held at rest in closed circuit, and put in operation when the current is intermitted; in this case the lower magnet r^3, instead of the upper one, is similarly employed, with a similar opposing spring.

It thus appears how the apparatus is at once available for use, with immediate positive advantage, on any circuit already operating an electric bell of the ordinary vibrating type, by simply detaching the conducting wires of this "ringing circuit" from the old bell magnet, and making them lead to and from the upper detent-controlling magnet r^3. But, as already explained, it is still more advantageous to connect directly into the line circuit and employ its current immediately upon either one or the other of the detent-magnets r^3 r^3 (according to the normal condition of the line circuit).

In any special case requiring it, when the line circuit employed is normally open, its current may, on the instant succeeding its initial movement, and after starting the train, be automatically cut out (and also, after due continuance of alarm, automatically restored) at the contacts *t* and t^2, or at the commutator t^4: only a momentary impulse of the line-battery, through magnet coil r^3, being required to set the train in operation and leave it in operation indefinitely. A spring-controlled cam or latch *P* retains the detent, meanwhile, in the position of re-

lease. Similarly, only a momentary impulse of the same battery on a branch circuit, through magnet-coil r^3, is required, to fill the detent lever back over the latch to the position of arrest; and leave it so till the bell is again called into action as before.

By such automatic cutting-out the work of the battery is economized: also, in special cases, where certain familiar devices may be in use, or preferred for governing the line-circuit, an excessive use of the detent, in responding once for every wheel instead of once for every train, is avoided.

Whenever the line circuit-closers of both releasing and arresting magnets happen to be covered simultaneously, the alarm will still be given; and will continue until the alarm circuit has been finally broken by advance of the train, or by a hand switch when there may be occasion.

If desired, a gearing connected with the motor, as f^2 leading to f^{10}, may be adapted to afford a visual signal to accompany the audible signal produced by the bell.

When in service as a crossing-alarm, there should be a rewinding at each regular tour of the sectionmen, as this is repeated, generally, with a frequency somewhat proportioned to the number of trains. At a 200 train crossing, there might be a daily rewinding; at a 20 train crossing, less frequently visited, the windings may be proportionately fewer.

The apparatus may also be put to service, at stations, freight yards, etc., as a single stroke signal, by a very simple modification of the detail, in which case the occasion for rewinding will recur only at very long intervals. This device is the property of the Boston Electric Railway Signal Co., of 209 Washington St., Boston, Mass., and its efficiency has been well tested by continuous use.

The Design and Construction of Railway Shops.

(*Continued from p. 365.*)

GENERAL REPAIRING OR ERECTING SHOP.

The amount of floor space to be devoted to the general repairs of locomotives and tenders, and its proportional division among the various buildings, is a wide question, on which little has been written; and in attempting to find an average taken from existing practice, difficulty is experienced, due to so many workshops manufacturing supplies for outstations and for other departments, even when not manufacturing new engines.

Simply for repair purposes, the author is of opinion that there should be floor or stall room in the erecting (repair) shop for 10 or 11 per cent. of the total engine stock. It may be expected that 4 or 5 per cent. will be in the paint shop going out, or in yard waiting to come into erecting shop for general repairs, and that 5 per cent. are having their boilers washed out, or undergoing running repairs of so trivial a nature that they can be done in the engine house. This leaves 80 per cent. of the motive power effective and at work daily.

To illustrate, we will suppose the total number of engines on a railway to be 100; the working engines make a daily average of 133 miles or 4,000 per month, which multiplied by the 80 effective engines gives 3,840,000 miles per annum, and the repairs done in the erecting shop have to balance the wear and tear of this mileage.

The first question is one of time: How long does it take to repair an engine? An average common in American shops is—

Heavy repairs occupy 90 days, equivalent to a wear of 100,000 miles.

Medium repairs occupy 60 days, equivalent to a wear of 70,000 miles.

Light and specific repairs occupy 30 days, equivalent to a wear of 30,000 miles.

General average is 60 days (2 months) to a wear of 67,000 miles.

Each engine on a general average, occupying a stall for two months, gives the output of repaired engines for an erecting shop containing ten stalls as 60, which multiplied by the average mileage of 67,000 totals to 4,020,000, a sum just in excess of the mileage during the same period by the 80 effective engines.

There is (or should be) some relationship in size between the erecting and other shops of the locomotive department, and Table 1 gives from recent practice the comparative area of the other shops in percentages of the erecting shop.

It will be seen that the proportions vary; and it must be so when some establishments build more or less new work, while others are restricted to repairs only; some are confined to locomotive work, whereas in others material is manufactured for all departments, including even the telegraph department.

Also the "size" relationship will be varied by the uniformity and interchangeability of the parts of the engine stock. Where their classes and styles are few, all the shops will be comparatively small, and the delay to engines in the erecting shop less. Thus, any such table will only permit of a mean average being taken.

This being the case, under each heading is a second column, in which the size of each shop is given as a percentage of the whole, so that, given the total roofed surface that can be devoted to the locomotive department, its proportionate divisions can be approximately inferred.

In America, the ordinary arrangement for erecting shops is, that the pits or stalls lie transversely to the main axis of the building, admission to them being by a transfer table or traverser, within the building in northern latitudes, and outside it where snow is likely to cause but little inconvenience. There is an obvious economy in size and cost of structure when the traverser can be put outside; but its free movement cannot be insured during a Canadian winter, and an attempt to use one in Montreal was, after much inconvenience, abandoned years ago. Hence, the shop must be wide enough for its work, and for the length of the traverser in addition, at once giving a span of roof justifying the use of intermediate supports. Two rows of pillars are often used, dividing the floor space into three bays, one on each side of and parallel with the traverser pit, as this brings the work and men close to the side windows. When the traverser is outside, it is rarely that the floor is obstructed with more than one line of pillars. Whatever be the number and disposition of these internal supports, the roof is invariably of the single ridge or gable pattern.

TABLE 1.

Showing the relative area of Railway shops for Locomotive Department. The first column gives the percentages in comparison with the erecting shops which is taken at unity (100); and the second column the percentage of the total roofed area devoted to locomotive purposes.

Kind of shop.	Hornellsville, N. Y., L. E. & W. Ry.		West Burlington, C. B. & Q. Ry.		Scranton D. L. & W. Ry.		Indianapolis G.S. L. & P.Ry. (Panhandle.)		Chicago, C. & N. W. Ry.		Howich, L. & Y. Ry.		Waterv'lie M. C. Ry.	
	Per ct. of erecting shop.	Per ct. of whole.	Per ct. of erecting shop.	Per ct. of whole.	Per ct. of erecting shop.	Per ct. of whole.	Per ct. of erecting shop.	Per ct. of whole.	Per ct. of erecting shop.	Per ct. of whole.	Per ct. of erecting shop.	Per ct. of whole.	Per ct. of erecting shop.	Per ct. of whole.
Erecting	100	29	100	23¾	100	34	100	14	100	15	100	39½	100	35
Machine	100	29	100	23¾	61	21	*150	21	200	30	24¾	10	*100	35
Boiler	50	14	63	15	44	15	111	15½	72	11	22½	9	18	6
Smithy	43	12	63	15	44	15	*178	25	110	16½	13	5	*20	7
Tender					23½	8			72	11				
Tool room	29	8	10	2½	16	5¾	29	4	15	2			*11	4
Engine & boiler hse.			85	20	3	1			56	9	17	6½		
Stores	29	8					100	13			21	8	30	10½
Offices														
Flue, copper and tin							55	7½	30	5½				
Foundry (iron)											13½	5		
Paint											14½	5½		

* Starred items give area of combined shop for Car as well as Locomotive department.

TRAVERSERS OR TRANSFER TABLES.

It was due to traversers being framed in timber that the pits in which they moved were at first so deep, even exceeding 5 ft. Rolled steel is now used for the frame, which is suspended from the axle journals on both sides of eight small wheels, and for which four parallel rails are provided, the full length of pit. Much ingenuity has been used in the endeavor to reduce the inconvenience of the pit, by making it as shallow as possible, and the Philadelphia & Reading Railway, in its new car shops at Reading, has no pit, only a flush asphalt floor from wall to wall. As, however, the suspended or carrying rails of the traverser must be higher than the fixed rail over which they move, it is arranged that the tracks at each repair stall, instead of being spiked to cross-ties, are carried upon longitudinal timbers about 10 ins. square, thus lifting them above the floor level, and giving the necessary difference in height between the traverser bed-rail and its suspended rail. The author is not familiar with any example on this continent of the European practice of making bed-rails for traverser and the transverse or stall tracks flush with each other and continuous, except where slightly cut at intersection to allow the wheel flanges to pass. The shallow rails on the traverser only just clear the bed track on the floor, and the vehicle to be transferred mounts to them by running up tapered extensions of the suspended rail that are hinged—or rather pivoted—on its ends, and which, when not pressed down by the wheels of the on-coming vehicle, are kept clear of the bed tracks by springs. This practice may be said to be a development of the "Dunn Traverser," at one time in common use for the transfer of carriages at terminal stations on English and Continental railways.

Having all rails flush, not only permits the rapid movement of men and small material, but allows the transfer, when traverser is engaged, of vehicles from a stall on one side of bay to the track immediately opposite. Having in view the possible failure of the traverser, some shops are, and all should be, provided with portable rails to span the width of pit.

Power to move the traverser is often communicated direct from boiler and engine carried upon it. This, though convenient enough perhaps for outdoor service, has proved to be an unmitigated nuisance under cover in winter, when doors and windows must be kept closed. Endless chains, the full length of the bed with stopping and starting gear at one end, are sometimes used. The friction is considerable, the chain having to be supported every 8 or 10 ft., and signals to control traverser movement have to be transmitted over long distances.

Stout wire cable, traveling at same speed as chain, offers less resistance, and if one of the forms of clip gear is used on the traverser, the single attendant traveling with it has its motion completely under control. The cable grip clip gear, used at West Albany, New York Central Railway, is a simple form of friction brake stopping the revolutions of a set of three geared wheels. When locked, the traverser moves at same speed as rope. Two sets of such wheels are used, so as to give both up and down motion. When table is at rest, power is transferred to a capstan used in hauling vehicles on and off the traverser. At Alton, Ill., Mr. W. WILSON causes a small, quick-moving rope to give motion to one wheel and shaft, from which power to traverser and capstan is communicated through bevel friction wheels. Speed of traverser is slow, 25 ft. per minute, and that of the capstan is but 32 ft. per minute.

The outdoor traverser, built some years ago for the Wason Car Shops, Springfield, is 50 ft. long, and weighs 11 tons, being propelled by a boiler and engine of 12 H. P. A steam pressure of 15 lbs. will move it without load; 30 lbs. with heaviest passenger coach on; and 60 lbs. gives it a speed of 500 ft. per minute.

An interesting and successful attempt has just been made at Aurora, on the Chicago, Burlington & Quincy Ry., to give motion to a traverser and capstan through an overhead electric wire with a small trolley running on it connected to a 7½ H. P. Sprague motor. Its rapid motion is geared down, so that table can be run either at 100 or 200 ft. per minute. The table is 65 ft. 9 ins. long by 15 ft. wide, and weighs empty about 15 (short) tons. The tractive resistance, unloaded, is about 250 lbs., equal to 17 lbs. per ton; loaded, it is 1,500 lbs. or 87 lbs. per ton. Experiments on the Coln Minden Ry., at

Deutzerfeld, give the resistance of a traverser and load weighing 20 tons at 440 lbs., equal to a tractive resistance of 22 lbs. per (long) ton.

Cotton ropes, moving at 3,360 ft. per minute, are used (under cover) at Cologne on the Rhenish Ry. for coach traverser, friction clutches being used to change the speed, so that the table has a motion of 197 ft. and capstan of 64 ft. per minute.

Erecting shops, equipped with traversers at low level, need in addition some means of lifting an engine off its wheels, and a hoist is usually fixed in the roof timbers either close to entrance or in centre of length of shop over the traverser bed. Lifting power is variously communicated to hoist by belt from shop shafting, by hydraulic pipe, by pneumatic pipe, and even by hand labor.

The European practice of making the erecting shop narrow compared with its length, using three (or at most four) longitudinal tracks, and spanning them for their whole length with overhead power traveling cranes, has not often been adopted in America, although we have specimens at the Canadian Pacific Ry., Montreal, Altoona, West Burlington, Indianapolis, Roanoke, and at Hamilton, Ont.

Why so effective a method has been comparatively neglected, it is not easy to say, as by its use there is an economy in floor space, and the cranes can do duty for both traverser and hoist. Undoubtedly the roof, or a portion of it, must be carried up higher, so as to give head room for the cranes and their load to pass over engines being repaired; but the interest on this outlay and on that of the cranes (often exceeding the cost of both traveller and hoist), is but a fraction of the money and time saved in the daily working of the shop.

Two fish-bellied plate girders, extending from side wall to side wall, with their ends supported on plate box trollies, usually form the crane bed, and carry one—or better still, two—travelling crabs. An independent boiler on crane, as a source of power, is now rarely used; but from the shop shafting motion is communicated to the crane by quick-moving ropes of steel wire, hemp, cotton or rawhide. If the distance crane has to travel is short, say under 150 ft., or if it is used in the foundry where heat and dust would materially shorten the life of a fibre rope, then longitudinal shafting (grooved or square), supported on tumbling bracket journals, is often used. In almost all cases where the winch forms part of the trolley, the transfer of motion to it from the end of crane is by such a shaft, although in the original cranes of this class designed by Mr. RAMSBOTTOM the high-speeded cord was carried along the crane girder through the trolley to opposite end, and then back to side wall, bending the cord often and shortening its life.

Messrs. Fowler of Leeds use steel wire rope similar to that used in steam ploughing, their 12-ton crane being equipped with a ⅝ in. diameter rope, moving at 270 ft. per minute. One, of 40 tons capacity and 50 ft. span, has the rope speeded to 400 ft. per minute, giving a slow lift of 2 ft. and a fast one of 4 ft. per minute, with a cross traverse of 28 ft., and a longitudinal motion of crane and load of 30 ft. per minute.

A 20-ton crane, using manila rope of full ¾ in. diameter, running at a speed of 2,540 ft. per minute, has a slow lift of 3 ft., and a quick one of 51 ft. per minute, with a cross traverse of trolley carriage of 16.8 ft., and a motion of the whole crane of 47.5 ft. per minute. It has the hoisting winch at one end, thus permitting the use of a 45-ft. span single box-girder, partially open below, the trolley carriage travelling inside the box on the angle-irons forming the lower web.

The seven original Ramsbottom cranes at Crewe used long-fibre cotton rope ⅝ in. diam., weighing 1⅛ oz. to the foot, having a tension of from 17 to 18 lbs. and a speed of 5,000 ft. per minute. Larger diameters, lower speeds, and cheaper material are now used, as at Swinden, where 4½ in. rope at 970 ft. per minute is employed. Messrs. Penn have used rawhide rope moving at 1,500 ft. per minute; and a 50-ton crane employed on dock work has had five years' service, without showing any wear on rawhide rope of 1½ in. diameter.

At Aurora and Altoona, cotton rope with speeds of 5,000 ft. per minute is used, giving, with the 25-ton cranes of the latter, a slow lift of 15 ft. and a quick lift of 81 ft. per minute, a crab traverse of 30 ft. and a crane travel of 50 ft. per minute.

The two cranes at Alton have each two crabs, so that the engine is suspended and independently moved at the four corners, a decided convenience when dropping frame and boiler on the wheels.

Where possible, it is an advantage to put the crane attendant's platform below the main girder and close to the wall, so that the work below, and not the crane machinery, is in his view.

Pneumatic floor cranes for light weights, although not common, are used at Wilmington on the Philadelphia, Wilmington and Baltimore Ry. and at the Paige Works, Cleveland. The Missouri Pacific Ry. uses compressed air at from 60 to 80 lbs. pressure, to work small three-cylinder Brotherhood engines for giving motion to boring, valve facing, and other portable machines, the air being compressed by a Westinghouse brake pump and distributed through small pipes. In the engine house, or in the shop after ordinary working hours, such portable motors can be coupled by rubber hose either to the air pump or the boiler of the nearest locomotive in steam.

The pneumatic transmission of energy is not in itself economical; but for the small powers mentioned, it is far cheaper than shafting and more rapid than using manual labor.

At Seraing all classes of shop cranes are pneumatic. The reason for this practice is that, with the large area under continuous roof, the volume of pure cool air exhausted is of value in assisting ventilation and increasing the general health of the workmen.

Our shops, sheds, and freight houses are rarely designed with the object of reducing manual labor in lifting, and many of us feel the regret expressed by Mr. DON J. WHITTEMORE, ex-President American Society of Civil Engineers: "I could not prevail on our people to make use of cranes to the same extent that they are used in England, and in this we are at fault." As an afterthought, pillar and other fixed cranes are occasionally applied, but their value and efficiency is limited, and for equal outlays, by far the most economical results follow the use of movable cranes. Hoisting by unskilled labor is one of the most expensive parts of the old-fashioned plant which American shops yet retain. Recent experience in the use of hydraulic drop-pits for removing single pairs of wheels (although with all its advantages an inelastic convenience) provokes such strong commendations and approval as a labor and time-saving machine that it is probable that the period is not far off when overhead power lifts will be common in our shop equipment. The wear on the metal work of cranes is not rapid, and an allowance of 5 per cent. per annum on first cost covers all depreciation, except in the matter of lifting chains, which require care and frequent testing. Wire rope has replaced lifting chains with economical results, its only defect being an increased diameter in pulleys and drums, the increase (about 25 per cent.) not being excessive, as the speeds are slow.

To support an overhead travelling crane track, the plan usually adopted is, to increase the thickness of the brick side-wall pilasters, and arch over the window and door openings flush with pilasters up to the elevated track level, thus securing a solid, safe support for crane travel, with the disadvantage of materially reducing the width inside shop and the window openings. Rolled iron, bolted to the walls, both for pillars and girders, would to-day be the better practice. A good arrangement is to use stout cast-iron pillars to support both the crane track and the roof principals, filling in between them with walls of just sufficient thickness to keep out the weather. It is difficult to use a single section of wrought iron for this double purpose, as the support for the track must be bolted on its side, and the weight from the crane is not then brought directly over the foundation, resulting in a tendency to throw the heel of the pillar outwards, and put the roof principal into compression. By using cast iron pillars, and varying their shape at the upper end, there is no difficulty in bringing the crane weights vertically on the underground foundations. The author is not familiar with any example of a cast-iron pillar doing such double duty in any northern climate.

(TO BE CONTINUED.)

A ROMAN AQUEDUCT has been lately cleaned and put in order at Sabelles, Spain, and now supplies the town with water.

PERSONAL.

Mr. JOHN CREERAR, of the railway supply firm of Creerar, Adams & Co., died in Chicago, Oct. 19.

Mr. W. A. DOANE, Mem. Am. Soc. C. E., has been appointed Prin. Asst. Eng. of the Norfolk & Western R. R.

Mr. C. A. SCOTT, C. E., of Seattle, Wash., was fatally injured on Oct. 8, by being knocked from a trestle by a cable car.

Mr. THOMAS BUTTERWORTH, formerly on the Wabash, has been appointed Master Mechanic of the Detroit, Lansing & Northern Railroad.

Mr. ISAAC R. JOSLIN, Mechanical Engineer and Vice-President of the S. A. Woods Machine Co., died in New York, Oct. 20.

Mr. W. E. SOARE died at Port Rowan, Ont., Oct. 11. He was Chief Engineer of the Buffalo & Detroit River Railway and of the Harbor of Refuge Survey.

Mr. HENRY S. MARCY, of Albany, N. Y., has been elected Vice-President and General Manager of the Fitchburg Railroad, with headquarters in Boston.

Mr. E. E. BUCHANAN, of the Union Bridge Co., at Athens, Pa., has resigned his position, having become one of the proprietors of the Elmira Bridge Co., at Elmira, N. Y.

Mr. C. O. WHEELER, Superintendent of the Wisconsin Central system, has accepted the General Superintendency of the Atchison, Topeka & Santa Fé system and will take charge Nov. 1.

Mr. JAMES G. DAGRON, M. Am. Soc. C. E., has been appointed Engineer of Bridges of the Baltimore & Ohio, as stated in our issue of Sept. 28; and not J. J. DRAPER as stated last week.

Mr. W. C. AMES was married at Warrenton, Va., Oct. 16, to TALLULAH, youngest daughter of the late WM. H. JENNINGS.

Mr. A. H. EVANS, who, for 25 years, was on the Cincinnati, Hamilton & Dayton lines, and part of the time Superintendent of the C. H. & I. division, has accepted a good position on one of the Southern roads.

Mr. J. C. STUBBS, who has resigned as General Traffic Manager of the Southern Pacific, has accepted the position of Second Vice-President of the Chicago, Milwaukee & St. Paul.

Mr. J. C. CARSTENSEN has been promoted to the controllership of the New York Central, a position that has not been filled since the death of Mr. ISAAC P. CHAMBERS. Mr. GEORGE PRINCE will succeed Mr. CARSTENSEN as Assistant Treasurer.

Mr. A. W. EGGLESTON, Roadmaster of the Hudson River division of the New York Central, has been transferred to White Plains, and placed in charge of the Harlem branch. Mr. N. H. BUTLER has been appointed Assistant Roadmaster, with an office in Albany.

Mr. JAMES WALTERS, who died at Minneapolis, recently, was formerly Superintendent of the Menominee Locomotive Works at Milwaukee, Wis. He built the first locomotive run on the Milwaukee & Mississippi Railroad, now part of the Chicago, Milwaukee & St. Paul system.

Mr. JARED E. REDFELD, of Essex, Conn., died Oct. 20. He had been largely interested in railway operations in the West and Southwest, and was at one time President of the Little Rock, Mississippi & Texas and the Columbus & Eastern railways. He was some years ago connected with the late Gov. JEWELL in one of the schemes for a new road between New York and Boston.

BOOK REVIEWS.

Catalogue of Interlocking and Railroad Signalling Appliances. The Johnson Railroad Signal Co., Rahway, N. J. Large 8vo. pp. 140.

Any concern nowadays which manufactures some complicated speciality seems to find it necessary, or at least expedient, to publish almost a treatise on it in the form of a catalogue, and much of the best and latest technical literature is to be found in such catalogues, of which the handsome volume now under discussion is one of the best examples. We rejoice at every evidence that the important art to which it is devoted is attaining more prominence in this country, for it is the greatest of all safeguards against accidents by rail, train brakes alone excepted, and is certain to become with every year continually more important in this country. We are as yet regrettably and improperly backward in availing ourselves of this comparatively new art. Whereas practically all the railways of England, where the system originated, use block signal and interlocking apparatus throughout their lines, in this country their use is still the exception, and comparatively few, even of railway officials, outside of a few great systems, have as yet a clear understanding of what the system really is.

The present volume, therefore, opens very appropri-

ately with a clear but general exposition of the history and merits of interlocking, starting from its first introduction into this country in 1874. This is followed by a brief article on block-signalling, in which the question of automatic vs. non-automatic signalling is thus spoken of:

If automatic signalling could be relied upon, it would probably be accepted as the most satisfactory and would certainly be the least expensive; but unfortunately it cannot always be relied on, and when it does fail, there is nothing to tell an engine-man that it has failed. There are automatic signals, no doubt, that show a very good record, but they are by no means without failures. It is comparatively easy to construct and fix signals that in case of failure go to the danger position, but *as soon as this happens with any frequency* (italics ours) engine-men regard the signal with suspicion and either run so slowly as to lose time or run with reckless disregard of what the signal shows. As we do not make a specialty of automatic block signals we must leave this question with the above expression of our opinion with regard to them.

The force of this sentence lies in the italicized hypothetical clause. Do these failures, or do they not, happen with "any frequency," i. e., with frequency enough to produce the effects upon trainmen noted? It is a question of effect. There is no question that there would be a point at which this effect would be produced; there is as little question that this is the only serious, not to say the only possible, element of danger in the system, and that, with this eliminated, automatic block signalling might *ipso facto* be both the cheapest and the surest. We can only say that, in some cases at least, the automatic systems have run for years with marvellously few errors, and that in our belief it is possible, and will in time at least be accomplished, to reduce the number of errors to so insignificant a percentage as to open a wide field for the introduction of these automatic systems, where the more costly tower systems have little chance for adoption. In the meantime we have no quarrel with those who prefer the system of combined interlocking and block-signalling, which doubtless for very heavy traffic is the most suitable and satisfactory; nor even with those who employ "human" block signalling, pure and simple. Although experience has shown that this system will sometimes fail, with disastrous results, yet on the whole it is a great safeguard, and vastly safer than any system of train dispatching only.

The question of block-signalling is not discussed at length, however, and the matter in regard to it is followed by a detailed description of the Johnson interlocking machine, which is claimed to have some decided advantages, as notably in its latch actuation, in the accessibility of the locking for repairs or changes, and in the simple and strong forms of the locking dogs. It is generally admitted to be an excellent machine. An example of a simple junction is marked out in detail.

The usual long lists of detail parts, for convenience in ordering, follows, an interesting feature being the Johnson selector, by which one lever controls a number of signals, the particular signal set being controlled by the position of the switches. This highly ingenious appliance, which is yet simple, and the following details of detector bars, compensators, signals, signal fittings, etc., give one a vivid idea of the degree of elaboration which has proved to be necessary to meet all requirements, and which yet is found to be not inconsistent with continuous and effective operation. Could any one have appeared in the first instance with a model of one of our large modern interlocking plants, before experience had established its practicability, and proposed its practical use, he would have been regarded as a lunatic. As it is, such a plant is one of the most complex of all the rougher machines, and it is amazing that it gives so little trouble by disarrangement.

The volume closes with some examples of special crossings, and with the usual lists of minor details. It is in all respects a highly creditable publication. The President and General Manager of the company, Mr. CHAS. B. JOHNSON, has had a long and (for this country) almost unique experience in all branches of interlocking, and this catalogue bears strong evidence to the fact that he has profited by it to obtain a very thorough comprehension of the design of and requirements for all forms of interlocking plant.

PUBLICATIONS RECEIVED.

—*Steam: Its Generation and Use.* with catalogue of the Manufactures of The Babcock & Wilcox Co., New York. 20th edition, large 8vo, pp. 120. Well indexed.

This is another of those valuable trade publications of real scientific value, of which we have had occasion to speak in another review. It is of course largely devoted to boilers of the water-tube type, and notably to the Babcock & Wilcox variety. The general matter about steam is not always especially new, but the form of presentation is good, and within its special scope it is a most valuable publication containing much information not elsewhere readily found, well worthy of study and permanent preservation, as we have shown more fully in reviews of earlier editions. The present edition is considerably enlarged.

—*Interstate Commerce Commission Reports.*—(1) Disproportion between local and through rates, and relative rates on grain and grain products, 14 pp. (2) Greater charge for the shorter distance and reasonable rates on lumber, 18 pp. (3) Car lot rates on live cattle 12 pp. Pamphlets, each 6 x 9 ins.

We should think some confusion would arise in handling these pamphlet reports of the Commission from the fact that they are unprovided with any serial number. As the issues multiply and copies of early reports become desirable for reference, the long and rather indefinite titles will be awkward things to use when it is desired to refer to any particular one of these pamphlet reports.

—*Commissioners for the Erection of the Public Buildings (at Philadelphia). Reports of Committees on Water Supply, Warming and Ventilation, Fitting up and Furnishing Rooms, and on Elevators, etc., etc.* Printed for the Commissioners, 1889. Paper, 1888.

These reports will be of interest to similar commissioners in other cities and to all particularly interested in details of finishing and furnishing public buildings and equipping them with all modern improvements. An explanation is given, with diagram, of the system adopted for numbering the hundreds of rooms in the new buildings.

—*Steel Car Axles*, pamphlet, 43 pp. The Pencoyd Iron Works, Philadelphia, Pa.

In this book are given in tabular form some interesting comparative transverse tests of steel and iron axles under one to forty blows with 1,000 lb. ram with a drop ranging to 25 ft. The illustrations are exceedingly well executed phototypes showing the 20-ton hammer at these works, the largest in the country, and also the axle-hammer and forge department interior view.

—*The Poetsch-Sooysmith Freezing Co.*, of New York, issues in bound form a series of interesting photographs showing the freezing process as applied by this company in sinking a shaft through quicksand at the Chapin Mines in Michigan. The process is also briefly described and a sectional view given of the material penetrated. The clear, sharp photographs of the frozen material, especially where this frozen quicksand joins the rock, are exceedingly interesting as showing the results obtained.

—*A Practical Treatise on Bridge Construction.* Being a Text-Book on the Design and Construction of Bridges in Iron and Steel for the Use of Students, Draughtsmen and Engineers. By T. CLAXTON FIDLER, M. Inst. C. E. London. Chas. Griffin & Co. 8vo. pp. 432, 239 cuts, 12 folding plates.

A book of many merits and some defects, at least from the American point of view, both of which we shall notice more fully later.

—*Temporary Catalogue of the Boyden Power Brake Co.* Baltimore, Md. 4to pamphlet,, pp. 26,

Contains full drawings of the main details of the apparatus which we have heretofore described. The system is interchangeable with the Westinghouse, and is offered at $175 per engine, $200 for driver brakes, $75 per passenger car, and $35 per freight car or tender.

—*The Railways of England.* By W. M. ACWORTH. London. John Murray. 8vo. pp. 427, 56 cuts and plates.

A very handsome publication containing a popular account of the leading English railway systems, and of English railway practice in general, having many points of interest and value which we hope to notice more fully later.

—*Institution of Civil Engineers Papers.* ASPINALL on "Friction of Locomotive Slide Valves," ARNOLD on "Strength of Bessemer Steel Tires," GUBBLE, TOPHAM, and VICKERY on "Surveying." BEAUMONT on "Friction Brake Dynamometers." These papers were issued early in 1889, but have escaped our previous lists.

—*A Dictionary of Electrical Words, Terms, and Phrases.* By EDWIN J. HOUSTON, A. M. etc. New York. The W.J. Johnston Co., Ld. Large 12mo. pp. 655, 396 cuts. $2.50.

A valuable and convenient work of reference, which we shall notice more fully later.

—*Illustrated Catalogue* of Tippett & Wood, Phillipsburg, N. J., builders of iron bridges, turn-tables, roofs, water-towers, stand-pipes, tanks, boilers, digestors, stacks, heaters, riveted pipe, blast furnace and mill work. Size 10¾ x 7¾: 26 pp.

—*General Specifications for Highway Bridges of Iron and Steel.* By J. A. L. WADDELL, Consulting Engineer, Kansas City, Mo., 2d edition 8vo. pamphlet, pp. 64.

SOCIETY PROCEEDINGS.

Engineers' Club of Philadelphia.—At the meeting on Oct. 5, Vice-President ARTHUR BEARDSLEY in the chair, Mr. GEO. N. BELL presented a paper upon "The Development of Suburban Property," in which it was clearly shown that this cannot be done to the best advantage without the assistance of systematic and intelligent engineering and landscape gardening. The paper and kindred subjects were discussed by Prof. ARTHUR BEARDSLEY and Messrs. T. M. CLEEMAN and HOWARD MURPHY.

HOWARD MURPHY,
Secretary and Treasurer.

Engineers' Society of Western Pennsylvania.—At the meeting of the Society at Pittsburg, Pa., on Sept. 17, President JOHN A. BRASHEAR in the chair, the subject for consideration was the appointment of a committee to meet a committee of the American Society of Civil Engineers, to discuss the question of forming one great engineering society. It was finally decided to appoint a Committee of Three.

An informal discussion followed on muddy river water and the contamination of rivers.

Engineers' Club of Cincinnati.—At the last regular meeting, the subject for discussion was the cause of and the best means for preventing the creeping of rails in the track on bridges and viaducts, and was suggested by the trouble from that cause in the tracks of the Chesapeake & Ohio R. R. bridge at Cincinnati, where the rails are found to be moving from 1 to 3 ins. per day.

J. F. WILSON, *Secretary.*

Engineers' Club of St. Louis.—At the regular meeting on Oct. 9, President MEIER presented a discussion of a new tractor recently invented by H. L. VAN ZILE, an engineer of Albany, N. Y. The invention had resulted from certain mathemetical investigations, and rendered it possible to make the total power, or pulling force, available for traction. A model had been made, which easily mounted a 20 per cent. grade, while the same model, without the improvement, could ascend only a 10 per cent. grade. In the discussion, ROBERT MOORE called attention to the similarity of this device to the Fell tractor, which was in successful use on the Summit Railway, over Mont Cenis. Prof. GALE spoke of the probable advantages this motor would have for street railway work, where the grades were serious, and where objections existed to the use of other forms of tractors.

Mr. C. H. SHARMAN then read a paper on "Some Reminiscences Connected with the Construction of the Union Pacific Railroad." Mr. SHARMAN entered the engineering department of this road in 1866 as rod-man, and remained on the work in various capacities until the completion of the road in 1869, when he held the position of division engineer. A graphic description was given of the difficulties met with in engineering construction at that day at points remote from civilization. Considerable interesting engineering data were presented, but the paper in general deviated somewhat from the strictly technical papers usually presented, being of a more popular character.

WM. H. BRYAN, *Secretary.*

American Society of Railroad Superintendents.—The eighteenth meeting of the Association of North American Railroad Superintendents was held at the Hotel Brunswick, New York, Oct. 7. The meeting was called to order by the President, C. S. GADSDEN, of the Charleston & Savannah Ry. Some thirty members were present, among whom were the following:

C. S. GADSDEN, Charleston & Savannah R. R.
JAMES DONNELLY, Lehigh Valley R. R.
J. B. MORFORD, Michigan Central R. R.
P. S. O'ROURKE, J. M. METHEANY, } Grand Rapids & Indiana R. R.
JOHN F. DEVINE, Atlantic Coast Line.
H. H. VREELAND, New York & Northern.
J. H. AVERILL, South Carolina R. R.
F. K. HUGER, East Tenn., Va. & Ga.
K. H. WADE (late of Wabash R. R.)
D. W. SANBORN, Boston & Maine.
R. M. SULLY, Petersburg, R. R.—Atlantic Coast Line.
J. W. FRY, Cape Fear & Yadkin Valley.
J. A. LARNED, Jacksonville, Tampa & Key West.
R. G. FLEMING, Savannah, Florida & Western.
C. W. BRADLEY, West Shore R. R.
F. S. GANNON, Staten Island Rapid Transit.
W. H. TURNER, N. Y., N. H. & H.
G. W. BEACH, N. Y., N. H. & H.
I. D. BARTON, W. E. BURROUGHS, W. E. LEWIS, } Long Island R. R.
C. F. SPAULDING, New London Northern.
C. A. GILCHRIST, F. M. & N. W. R. R.
A. HAMMOND, Boston, Revere B. & Lynn.
W. I. ALLEN, H. F. ROYCE, } Chicago, Rock Island & Pacific.

The report of the Executive Committee was presented by the Chairman, President GADSDEN, presenting the order of business for the meeting and calling attention to certain financial recommendations. Prof. C. HERSCHEL KOYL, of Easton, Pa., read a very interesting paper on the subject of signaling, describing the parabolic semaphore signal of his own invention, illustrated by a working model of his device. The distinctive features of his improvement consist in the original method of illumination by which the semaphore arm shows red, indicating danger, both by night and by day, when in a horizontal position, and white, indicating safety, both by night and by day, when in an inclined position, the effect produced rendering the signal visible at a much greater distance than the ordinary signals. (This signal was described and illustrated in ENGINEERING NEWS, Sept 28.)

The Committee on Rules and Headquarters rendered their report, stating that, in their opinion, it was not ex-

pedient to procure a permanent headquarters for the Association located at any one city or railroad center, believing that the best interests of the Association will not be served by having the meetings held permanently in one place, and that the members of the Association should become familiar with the practice of other lines than those in which they are engaged.

The Committee on Roadway presented a long and interesting report on the following subject referred to them:

1st, Form of rail sections.
2d, Method of securing the rails to the ties.
3d, Rail joint fastenings.
4th, Metal or wooden ties.
5th, Safety appliances.
6th, on the award of prize for best treatise on track work. Under the latter heading, the committee recommended that the prize of $50 offered at the meeting in St. Louis in September, 1888, be awarded to the paper bearing the motto "Thistle."

The Committees on Machinery and Transportation reported progress, and asked for further time, which was granted.

The Committee on Relations with the General Time Convention made verbal report, stating the interview with the Executive Committee of the Time Convention, together with the reply received.

The Association adopted a new form of constitution proposed at the last meeting, and printed with the proceedings of that meeting, the principal changes being as follows: the name of the Association was changed to the American Society of Railroad Superintendents. The scope of membership was enlarged so as to include in addition to the active members, honorary members, associate members and delegate members. The principal officers of the Association were made to hold their office two years, and the Executive Committee was enlarged. Some changes were also made in the duties of officers, and provision that the secretary should collect annual dues or other assessments, and transmit the same to the treasurer. The duties of the Executive Committee were defined, and the regular meetings of the Association were made annual instead of semi-annual, to be held in the fall of the year, the present officers holding over until the next regular meeting in the fall of 1890.

A paper by L. W. PALMER, Superintendent of the Providence Division of the New York & Northern Railroad, on the subject of "Terminal Charges" was presented; a communication was received from C. H. PLATT, Division Superintendent of the New York & New Haven, inquiring as to the practicability of designating the number and section of freight trains, either on the locomotive headlights or on the cabooses, and inquiring for information in regard to the use of such device, which has been put into operation on some roads, particularly the Chicago, Rock Island & Pacific.

A paper was read by the President, Mr. GADSDEN, entitled "The Open Switch," in which he recommended the drop-lever stand, which has been used in connection with the Wharton switch.

The annual assessment and membership fee was increased from $3 to $5. A committee was appointed to revise the by-laws and report to the next meeting.

American Forestry Congress.—The eighth annual convention of the American Forestry Congress, and the fourth annual convention of the Pennsylvania Forestry Association, were held as one convention at the Horticultural Hall, Philadelphia, Pa., on Oct. 15, 16, 17, 18.

At the opening meeting on Oct. 15, Mr. BURNET LANDRETH, President of the State Association, delivered a brief address of welcome, in which he referred to the early work of Philadelphia men in the study of American botany and forestry. In the absence of Governor BEAVER, of Pennsylvania, the President of the Forestry Congress, the Hon. H. G. JOLY, of Quebec, Canada, one of the Vice-Presidents, was called to the chair and responded to the address of welcome. After referring to the difficulty of arousing practical interest on the part of the public, and the opposition sometimes met with, he stated emphatically that the object of forest preservation is not to hoard the forest resources as misers hoard their treasure, nor to destroy the business of the lumberman. On the contrary, it is to effect a proper and rational care of the resources, to develop the forest products, check waste and improper cutting, and so foster the legitimate lumber trade; providing a continual and ample supply of timber for this trade as well as maintaining the standing forests necessary for the distribution of the water supply and the general protection of certain sections of the country. The restoration of forests in some districts has already become desirable if not necessary. He thought that Canada was wiser than this country in that the Government keeps control of the forest lands.

Hon. CARL SCHURZ made a short but interesting and forcible speech. He stated that the destruction of the forests is not due to the lumberman who cuts timber for his own use and profit, but to the lumberman who wastes as much as he cuts, to the settler and miner who devastate mountain sides for a small supply of timber, to the vast fires started by the carelessness of hunters and tourists, and especially to the timber thieves. About twelve years ago, when Secretary of the Interior, he particularly noticed the great extent of the work done by these latter people, cutting down whole forests belonging to the Government; but when he suggested measures to prevent this destruction of Government property, the objection was indignantly made that he was interfering with a legitimate business, and the proposed laws were rejected. In regard to the forestry work in Germany, he related one instance where a pine forest has taken the place of a barren waste. He claimed that the Government of the United States should adopt a forestry policy with a view to the preservation of its forests, and he also suggested the withdrawal of forestlands from sale and the acquisition of private forest lands by the State or national Government.

The first proceeding at the meeting on Oct. 16, was the presentation of the report of the Recording Secretary, Mr. J. B. HARRISON. The report discussed at some length the effect of the destruction of forests upon streams and water supplies. The water falling on the denuded areas flows away more rapidly, and gradually washes away the soil, so that the streams will be destructive torrents at one season, and their beds dry, dusty wastes for the rest of the year. He thought every State having forest lands should appoint an officer to look after the forests and the rivers, and to have supervision of the construction and maintenance of dams. He thought the question of forest preservation upon the water supplies should be a point of consideration for the engineers appointed by the Government to survey the arid regions and lay out systems of storage reservoirs. During an examination of the mountain forests of Pennsylvania in May, he had opportunity for observing the effects of very heavy rainfall, and of comparing the rate of descent of the water over the hillside areas, covered with forests, with the rate on areas of equal slope where the forests had been destroyed. In this region, as well as in the Adirondacks, he found that on the denuded hillside areas the water descended to the brooks and rivers much more rapidly than where the forests were still standing, or where, if cut down, the forest floor was still intact; and after a heavy rain the denuded areas became dry much sooner than those of similar slopes on which forest conditions had been maintained. The relation of forest destruction to this year's freshets cannot be determined even approximately without much more careful and thorough observation than the matter has yet received. The entire drainage area of a stream, lake, or reservoir would have to be examined with scientific accuracy, and the proportion of forest area and of denuded lands ascertained. Such investigations, if conducted by competent men, would probably make plain the necessity for some proportion of forest in every large watershed or drainage area in mountain regions, and the places at which forests would be most necessary for the protection of the streams and valleys could also be determined.

Reports were then received from the delegates from the sixteen States represented. Some of these reports contained interesting statistical matter, and their general tenor was the demonstration of the value of forests, both as standing forests and as resources of a mercantile commodity. The value of trees as a protection to crops was also referred to. Mr. W. MCLENDON, of Georgia, presented a carefully prepared report on the pines and relative industries, such as turpentine, etc., in which he referred also to the enormous consumption for railway ties, the average life of which on one of the largest systems in the State is only five years. Col. ENSIGN, Forest Commissioner of Colorado, referred to the extensive forest fires in the Rocky Mountains, and stated that last year the smoke from the great fires in Montana hung over and darkened the city of Denver, 800 miles away, and even drifted down to New Mexico. Col. JOHN S. TITCOMB, Deputy State Engineer of Colorado, referred to the project now being agitated for the establishment of a national park in Colorado on the same plan as the Yellowstone National Park in Wyoming.

At 1 o'clock there was a reception and lunch at the Aldine Hotel, tendered by the Committee on Arrangements. It was a very pleasant occasion, the badges worn being considered in themselves a sufficient introduction for members and delegates, and it might be noted that there was a much more easy and general intercourse, with less need of formal introduction, than is the case at some of the engineers' meetings, and there was much informal discussion and interchange of ideas. At the same time, a committee on introductions is a very desirable part of the organization of such meetings or conventions.

At the afternoon session, Mr. B. E. FERNOW, Chief of the Forestry Division, U. S. Department of Agriculture, presented a valuable and interesting paper on "Methods of Proposed Forestry Reform: Their Relative Value and Limitations." At the commencement Mr. FERNOW referred to the "sentimentalist" view of forestry as an erroneous and in some ways harmful one. There is no immediate approach of a timber famine imminent, and no immediate danger of a general disaster by floods or drought; neither is there any necessity of taking every flood or drought as an example of the undeniably careless management of the forests. He considered the forestry question as one of economics, and proceeded to discuss it at some length in this light, from an entirely practical and non-sentimental point of view, thus adding very much to the importance and value of his paper. His general conclusion was that the Government should take care of the national forests, instead of neglecting them as it is now doing.

In the discussion upon this paper Mr. JOLY referred to the system adopted by the Canadian Government. The timber lands are leased for one year, the letting being by public auction, and the lands being subject to a ground rent of $3 per acre. The licensee has to make sworn statement as to the amount of timber cut, and other particulars. If the licensee complies properly with the requirements of the law he is entitled to a renewal of his lease, but not otherwise. While this system has advantages; he did not recommend its adoption in this country.

At the meeting on Oct. 17, Gov. BEAVER, President of the Forestry Congress, in the chair, the first paper read was one on "Forestry Legislature in New York," by Mr. H. N. JARCHOW, and in connection with the paper some remarks on the progress and condition of forestry in New York were made by Hon. WARREN HIGLEY, in which he referred to the destructive work now in progress in the Adirondack region and the proposition for the acquirement of this region by the State.

The next paper was by Mr. E. E. RUSSELL TRATMAN on "Economy in the Consumption of Timber for Railway Purposes," showing the responsibility of railways in the matter of timber consumption, describing the principal purposes for which the timber is consumed, and suggesting means by which the consumption might be reduced with economy to the railway companies. Reference was made to the different methods of preserving timber, and to the use of preserved wood ties, metal tie plates, and metal ties for reducing the consumption of timber for ties. Other purposes considered for which railways consume timber, in some of which economy can be effected with benefit to the companies, were as follows: fences, telegraph poles and signal posts, bridges, trestles and culverts, stations and other buildings, rolling stock, fuel.

Col. EDGAR T. ENSIGN, Forest Commissioner of Colorado, then read a paper on "Government Forest Reserves in the West," in which a number of national parks or reservations were suggested, to be located at the head waters of the great rivers, such as the Colorado and the Columbia, and the large tributaries of the Missouri, such as the Arkansas, Platte, etc. At the afternoon session Mr. R. J. HINTON, C. E., of the Department of National Surveys, gave some notes on the recent trip through the West of the Senate Committee on Irrigation, showing the urgent need of some methods of checking the destruction of the forests by fire and axe. He suggested that a member of the Forestry Congress be appointed to wait upon this committee at its coming meeting in Washington, and to place the matter of forestry before it. Papers on "Removal of Forests a Factor in the Causation of Floods," by Dr. J. M. ANDERS, of Philadelphia, and "Forestal Schools," by Prof. ADOLPH LÉUE, of the Ohio State Forestry Bureau, were then presented.

In the evening Prof. J. F. ROTHROCK, of the University of Pennsylvania, gave an illustrated lecture on "The Forest Regions of North America," at the University.

At the meeting on Oct. 18, Mr. LOWERY gave some description of the establishment of a mulberry tree plantation and silk cultivation station in Alabama, and Dr. NORTHROP, of Connecticut, made a report on the observance of Arbor Day.

Resolutions providing for changes in the constitution and for changing the name to the American Forestry Association were voted upon and passed. A resolution was also passed, after much discussion, to petition Congress to pass an act withdrawing temporarily from sale all distinctively forest lands belonging to the Government, until a committee, which Congress shall authorize the President to appoint, shall have investigated the matter and decided what sections should be permanently preserved in the interest of a national forestry policy. In the discussion upon this resolution, Mr. WOODS, a Boston lumberman, referred to the fact that a few years ago Indiana was the general market for hard wood; that State became cleared and buyers had to go to Tennessee, and then still further, while now they have to buy it in small quantities here and there. Mr. HINTON, C. E., of the U. S. National Surveys, and who is connected with the Department of the Interior, made a powerful speech showing the relation of the forests to water supply, rainfall, and irrigation, and urging the adoption of a vigorous national forestry policy. As showing the great extent of forest fires, he stated that the Senate Committee on Irrigation passed for hundreds of miles through mountainous country where the smoke was so thick as to completely shut out the mountains from view.

The day having been appointed by the Governor as Arbor Day, the afternoon was devoted to tree planting in Fairmount Park, where suitable addresses were made. These exercises closed the meeting.

The following officers were elected for the year 1889-1890: President, Hon. J. H. BEAVER, Governor of Pennsylvania; Vice-President, Hon. H. G. JOLY, of Quebec; Corresponding Secretary, C. C. BINNEY, of Philadelphia; Recording Secretary, Dr. N. H. EGLESTON, of Washington, D. C.; Treasurer, Dr. H. M. FISHER, of Philadelphia.

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Advertising rates. 20 cents per line *agate measure. Schedule sent on request.* **Changes** *of advertisements must be in hand on Tuesday afternoon;* **New** *advertisements Wednesday afternoon;* **Transient** *advertisements not later than Thursday noon. The last pages go to press early on Friday, and we will be obliged if parties who fail to receive their papers promptly will notify us without delay.*

Drawings and Photographs *of all new engineering works or designs, large or small, of interest from their magnitude, novelty, or originality, as well as newly adopted* **Standard Plans** *for engineering structures or details, rolling stock, etc., are always desired for early publication. Also* **Brief Technical Notes** *of the cost or manner of executing work, tests of materials, machines or other new devices, and* **News of New Construction** *of all kinds.* **Letters** *for publication must be accompanied by the name or card of the writer.*

Coming Technical Meetings.

Engineers' Club of Philadelphia, Pa.—Next meeting, Nov. 2. Secy., Howard Murphy, 1122 Girard St.

Engineers' Club of Kansas City, Mo.—Next meeting, Nov 4. Discussion on Sewerage Systems. Secy., Kenneth Allen, 310 Baird Building.

Engineers' Club of St. Louis, Mo.—Next meeting, Nov. 6.

American Society of Civil Engineers, New York.—Next meeting, Nov. 6. Secy., John Bogart, 127 E. 23d St.

Western Society of Engineers, Chicago, Ill.—Next meeting, Nov. 7. Discussion on the Chicago Drainage Problem. Secy., J. W. Weston, 78 La Salle St.

New England Railway Club, Boston, Mass.—Next meeting, Nov. 13. Rooms in the United States Hotel.

Western Railway Club, Chicago, Ill.—Next meeting Nov. 19. Rooms in the Phœnix Building.

Engineers' Society of Western Pennsylvania—Next meeting, Nov 19. Secy., S. M. Wickersham, Pittsburg, Pa.

Boston Society of Civil Engineers.—Next meeting, Nov. 20. Secy., S. E. Tinkham, City Hall.

New York Railway Club.—Next meeting, Nov. 21. Rooms at 113 Liberty St.

WE have received, in common with almost every other adult male in the United States, we presume, a very ingenious diagram purporting to show "WHY ST. LOUIS IS THE PLACE FOR THE WORLD'S FAIR OF 1892." The diagram consists of a map of the eastern United States on which appear three great circles of 500 miles radius each, struck with New York, Chicago, and St. Louis as centers. About half the New York circle lies in the Atlantic Ocean, making that town appear a most improper place to hold the Fair in. Chicago's circle includes four great lakes and a large part of Canada (which is not credited with any population), making that town also appear rather out of the way. St. Louis's circle alone lies almost wholly on dry land and in the territory of the United States. The relative population in millions and miles of railway included by these circles are thus given on the margin:

	Population. 1880	1890	Incr. p. c.	Miles. railway
New York circle	20.12	24.39	21.2	34,369
Chicago "	21.80	27.43	25.8	54,801
St. Louis, "	23.84	30.58	28.3	77,571

The column of percentages of increase in population we add ourselves, and we question very seriously if the next census will closely correspond with it: but independently of that, while the argument is on its face a strong one, it is unsound in two respects. A similar circle struck with Cincinnati will show as much better results for that city, as compared with St. Louis, as St. Louis shows over Chicago, if the basis of comparison be admitted to be sound, while the basis is in fact highly delusive in that it allows as much weight to a million of people 300 to 500 miles off as it does to a million on the spot, who would probably contribute ten or twenty times as many visitors as they would if each had to make a long journey to reach the Fair. Equating population on this latter basis, however rudely, New York is far ahead of Chicago in probable attendants, and Chicago of St. Louis.

As bearing on the practicability of a permanent exposition building in stories, at reasonable cost, with say 100 acres of floor space in a 20-acre building, which would leave a liberal excess over what was needed for exhibits for resting places, outlooks, smoking rooms and restaurants, distributed about the building, it may be noted that the great Chicago Auditorium, which is a magnificent cut stone structure with a lofty stone tower 240 ft. high, covers an area of 1.45 acres, and has say 14.5 acres of floor space, or a seventh of what would be needed for the Exposition, making the cost per acre of floor in this most massive and costly building $206,000 and the cost of the iron work only, chiefly in roofs and floors, $24,100 per acre. The Boston permanent exhibition building, similarly, has 7 acres of floor, space in three stories, at a cost of some $72,000 per acre. Were we to estimate the cost of a gigantic 100-acre glass and iron crystal palace at $80,000 per acre, we should be estimating most liberally, which would make its cost, tower and all, $8,000,000, and be the best investment of the money which any city ever made, especially if it were on a commanding and impressive site, like Governor's Island, since it would enable the for tunate city to have, not only one Exposition, but a world's fair every ten or twelve years. A valued correspondent questions whether such a building in stories would be cheaper than an equal floor area in separate one-story buildings, on the plausible ground that, as a floor must sustain 100 to 120 lbs. per sq. ft. and a roof need only sustain 40 lbs., 2½ to 3 roofs could be built as cheaply as one additional floor; but this argument is delusive. The floor proper is constant for any arrangement, and the added cost of supports to hold it higher and of a symmetrical ceiling below it are the only items which go against the building in stories. On the other hand, to give any approach to dignity to a one-story building, the roof must be high, ornamented, and of wide span, so that its cost per acre is necessarily high. The most expensive of all ways of obtaining floor space is consequently to build dignified one-story structures.

THE London *Spectator* in a late issue devotes considerable space to aluminium and its effect upon the arts and industries of the future. The many precious qualities of the metal, discovered fifty years ago by WOHLER in common clay, are set forth, and a glowing picture is drawn of the day when this metal is to supplant iron. Ships and their engines are to weigh half what they do now; bridges are to be built of aluminium; and this new metal, "as light as wood and strong as steel," is to practically revolutionize our daily life. With our contemporary, we believe the day of this wonderful product is near at hand and that existing processes will soon reduce its price to a figure that will permit its utilization in the industries in a thousand different ways. But the *Spectator* errs in basing its hopes upon the pure metal instead of its still more valuable alloys with iron, copper, and nickel, and fails to note that the low specific gravity of aluminium will interfere somewhat with the realization of some of these dreams.

As compared with ordinary steel or iron, with a specific gravity of 7.8 and an elastic limit of 40,000 lbs. and 30,000 lbs. respectively, aluminium has a specific gravity of 2.6 and an elastic limit of 24,000 lbs. per square inch. Roughly speaking, the new metal is, section for section, about one-third as heavy as steel or iron, but in the same relation has 60 per cent. of the strength of steel and 80 per cent. of the strength of wrought iron. But to compete with present materials of construction, the price of aluminium per pound would have to be reduced to about 8 or 10 cts., a figure which the inherent difficulties and complex processes of reduction will probably never permit us to realize.

BUT as an alloy, aluminium is indeed a precious metal; and with its price per pound reduced to 50 cts. as promised now by metallurgists, or even to that of block tin as the still more hopeful workers fix it, its field of usefulness seems without limit. Ten per cent. of this metal added to iron would produce a ship-plate of great strength, taking and retaining a high polish, and possessing the eminently valuable quality of being absolutely proof against the corroding action of sea-water and the adherence of barnacles or other growths. It is this alloy, and not the pure metal itself, that is to form the hulls of our future ships, and the same metal may be employed in numberless equally useful ways. The journal referred to pictures a dome, like that of St. Paul's, overlaid with sheets of aluminium, with its polished silver-blue metal reflecting the rays of the sun, and even gleaming brightly through fogs and mist. But as an alloy with copper, a metal is obtained that rivals virgin gold in its beauty, and yet retains all the non-oxidizing qualities of the pure metal itself referred to. Other alloys produce a metal of great strength, suitable for gun-barrels, that will neither rust nor lead in use, and it is no idle dream to imagine, in future combinations of aluminium with other metals, the long-sought metal for modern artillery. For articles of luxury, in art, and even for the utensils of daily life, the pleasing colors and unchanging qualities of these alloys will doubtless bring them into common use. But instead of supplanting the age of steel by that of aluminium, as steel replaced iron and iron bronze, we believe the new metal is destined simply to render steel and iron more valuable still by imparting to them valuable qualities that they now lack.

THERE appears to be considerable misunderstanding in this country, if we may judge from our correspondence, in regard to the present practice of educating engineers in England. One correspondent this week makes the broad statement that there are no engineering schools in England corresponding to our own, but that all young engineering aspirants are trained in the offices of practising engineers, which they pay certain considerable fees for entering. The last part is, we believe, true enough. Even after graduating at a technical school, the next step must be to enter some office as a student

There is hardly a civil or mechanical engineer in England of any standing who has not a greater or less number of such articled students or pupils, although the same system has never obtained in this country outside of New England, and has almost died out there. It is doubtless also true that a much smaller proportion of the rising generation of engineers have a technical college training in England than in this country. But it is widely erroneous to suppose that there are no engineering schools in England, as a generation brought up on RANKINE might suspect, it would seem. The University of Glasgow, in which RANKINE was Professor of Civil Engineering and Mechanics, is a large and fine school. There is another fine school connected with Cambridge Univtrsity. There is also the Liverpool College, Owens College, Manchester, the Edinburgh School of Engineering, and Kings College, London, not to speak of the Chatham and other military schools, which do not properly count, and doubtless various others with which we are unacquainted. At least one large engineering works takes no pupils except those who have had a previous technical school training *and* are prepared to pay a premium of 700 guineas or some $3,570,—requirements which in this country would surely prevent their getting many pupils, since the young man who has been graduated from a technical school feels hardly used if he does not get $75 or more per month the first year thereafter, and twice that within four or five years.

IN the last number of the *Journal of the Franklin Institute*, is an address delivered before the members of that association by Major O. E. MICHAELIS, U. S. A., and a well-known member of the American Society of Civil Engineers. Major MICHAELIS takes as his text the equipment of the "Army of Kukuanaland" and borrows his characters from the famed story of "She." But the real purpose of the paper is to vigorously attack the obstinate and senseless survival of methods in our own army, long out of date; and to more than hint to the authorities in charge that many valuable ideas concerning the equipment of soldiers and the constructive details of gun carriages, battery wagons, horse harness, etc., may be gathered outside of the close circle of army officers themselves. In this day of change and general progress, the suggestions of the author are exceedingly timely and sensible, and army officers alone can explain, among other things, why the present weather-proof ammunition for our artillery is as carefully guarded in heavy limber chests as were the soft-wood sabots and the comparatively poor powder of old Frederick the Great or the Emperor Napoleon; why the contents of a village smithy and a country store are carried with every six guns of a battery, only to be "turned in" with the majority of the packages unbroken after a long campaign; why there is no improvement in the present absurd manner of connecting the gun-trail to the limber-chest in transport; and why many other changes are not made in equipment and methods that would not only vastly add to the comfort of the men, but make them still more efficient fighting machines. Major MICHAELIS is himself an exceptional type of that army officer who is constantly mingling with the busy world outside of the official circle, and, as his address shows, he has gleaned there many ideas of value in his own profession. The moral of the "Army of Kukuanaland" is that it is due to the people and to the best interests of our Government to take advantage of every "good thing" that presents itself, even if civilians, and officers not upon specially appointed boards, should suggest these changes in military administration and equipment.

IN surveying the Lake of Constance, the position of soundings was determined from the shore by a single instrument, sighting on a mast 5 m. long, divided into metres, and the top metre subdivided into decimetres, the decimetres 1, 3, 5, 7 and 9 being colored white, 2 and 4 red, 6, 8 and 10 black. Along shore a staff divided into centimetres was used. The total area surveyed was 13 sq. miles, 983 soundings being taken in 9 working days, the cost of the whole survey averaging only 14 cts. per sounding. The method is therefore one worthy of attention where many soundings are to be taken, but it occurs to us to suggest that with a transit provided with a gradienter attachment, which we regard as one of the most useful of modern innovations, very good results could be obtained by providing the boat from which soundings are taken with a mast having a fixed signal just 10 ft. above the water. The distances may then be read off at once from a table of reciprocals, and if all the vernier readings be taken in the form of bearings, the plotting also becomes very simple. In all kinds of transit work except curve-running, there would be great saving of labor and increase of accuracy if the practice were more common of setting the zero line of the vernier once for all on a north and south line, and never changing the reading except to turn off an angle, when the vernier and compass readings always correspond, and the notes are in proper form for convenient plotting without transforming angular notes into bearings. Some engineers prefer this system even for final location work, and it has something in its favor, but on the whole that extreme is hardly expedient.

WE are reminded by Mr. J. G. DONOVAN, Chief Engineer of the Fairhaven & Southern Railroad in Washington State, that we should add the Worcester Polytechnic Institute, of Worcester, Mass., to our list of technical schools which grant to their engineering graduates the degree of S. B. only. And we unite with our correspondent in hoping that this list will eventually cover every scientific school in the country.

The Possibilities of Sliding Railways.

Whether the *Chemin de Fer Glissant*, which has been the sensation of the Paris Exposition, and of which we give this week some further details, is to remain a mere scientific toy, or to advance, like the locomotive, into a most important practical machine, it is as yet too early to determine. It is already in about as advanced a stage as the locomotive was in 1829 at the time of the Rocket tests, i. e., it has been shown to be a workable possibility. Its future progress depends largely on whether the game is worth the candle; whether the possible gains are large enough to make it worth while to conquer the practical difficulties which are sure to arise as the scale on which the machine is worked enlarges. To see how this may be, we propose briefly to examine what the economic capabilities of such a sliding railway would be, if all the intermediate obstacles to its use on a large scale are overcome, touching but lightly upon those obstacles, as apart from the immediate question.

From whatever point of view we may study the matter, we shall find these intrinsic capabilities to be very great indeed, making it well worth while to watch the progress of the invention, and making it reasonable to hope that the very moderate obstacles to commercial success which as yet appear will in time be overcome, and perhaps quite speedily.

The essence of the invention is (1) the substitution of a thin film of water, over which the vehicle slides, for rolling wheels, the film being maintained by hydrostatic pressure, and so thin as to involve little more waste of water than wetting the rails by a sponge might; and (2) propulsion by successive jets of water under pressure, acting against a rib of buckets or a "rectilinear turbine," extending under the whole train, thus dispensing with all locomotive power.

That the film can be as well maintained on a large scale as on a small one is a reasonable assumption, in accordance with known physical laws, and the resulting frictional resistance is alleged to have been shown by experiment to be reduced to less than one pound per ton, or practically even to nothing, instead of the usual six to eight pounds per ton. It is also claimed for this mode of propulsion that both theory and practice indicate as great efficiency for the rectilinear as for the usual circular turbine, or say 70 to 80 per cent., a result which may be provisionally admitted as at least a reasonable possibility. What, then, is to be gained by such a system?

The first and most obvious gain is the saving in the weights of the running gear of cars, which are a much larger proportion of the total weight of trains than is commonly understood. The following figures show fair averages for various types of cars:

	Total wt. lbs.	*Trucks* lbs.	*p. c. Capacity trucks*	*Capacity* lbs.
Sleeping cars	70,000	32,000	45.7	
Passenger cars	45,000	14,500	32.2	
Box cars	25,000	9,000	36.0	50,000
Stock cars	26,000	9,000	34.7	30,000
Gondolas	18,500	9,000	48.6	40,000

The great saving shown, fully one-third in freight cars and more than that with passenger cars, is practically net, because the lower center of gravity, less violent oscillations, and other causes to be noted, should enable enough weight to be saved in the body of the car to balance the weight of the sliding shoes.

But there is another still greater gain of this kind, the saving of the weight of the locomotive and its loaded tender. How great the loss is from moving these ponderous machines back and forth and up and down is but little appreciated. A heavy train of six sleepers and the three other cars may weigh 250 tons; the average passenger train of this continent not over 200 tons; while the engine which hauls them will weigh 65 to 70 tons. Consequently, out of the heavier train, weighing with engine, say . . . . . 320 tons
We save, first, the weight of the engine . . . . . 70 tons
Secondly, one-third the weight of cars . . . . . 83 tons 153 tons
Leaving as the equivalent weight for "sliding" train . . . . . 167 tons

This being for a very heavy train, we may say in round figures that the equivalent weight for a "sliding" train of equal passenger capacity would be but about half the present weight.

For freight trains the difference would be less extreme. Still, the average American freight train, which carries far more than any other in the world, carried last year in paying freight only* . . . . . 156 tons
The average weight of cars was certainly more than this, including movements of empties, and may have been . . . . . 180 tons
The average freight engine and tender weighed not less than . . 70 tons

* See ENGINEERING NEWS, Aug. 17, 1889.

A total average freight train weight of	406 tons
Deducting the weight of engine and one-third the weight of cars, or .	130 tons
We have left as the equivalent weight for a "sliding" train . .	276 tons

A saving of 32 per cent.

The article in *Lé Genie Civil*, from which we make an abstract in another column, computes as greater reduction as from 133 to 31 *tonnes*, but we cannot follow so large a claim.

In a rough way, therefore, we may say that half the weight of passenger trains and a third of the weight of average freight trains would be saved. On heavy grades the saving in freight service would be vastly greater, the weight of the engine alone being often a quarter to a half of the whole weight of the train.

But even this does not exhaust the possible economies in this direction. It is one of the unfortunate defects of the locomotive that its power cannot be increased according to the demand, but is strictly limited by the adhesion. Accordingly it is necessary to cut down the train to what the engine can handle on the steepest grades, which may extend over only 10 per cent. of a division, while on the remaining 90 per cent., an unnecessarily heavy engine is shaking itself and the track to pieces at almost as great cost as if it were fully at work, thus greatly increasing the number of through trains which it is necessary to run in order to get a given tonnage over the road. The "sliding" type is reasonably claimed in another column to be able to overcome grades of almost any steepness by the simple expedient of increasing the number of jets acting at one time on the train. It follows that by this plan the length of trains can be adjusted to the average rather than to the maximum grade of each division.

Finally, there is the enormous gain of having the most perfect of all possible brakes, requiring only that the hydrostatic pressure shall be shut off from the shoes to let them down upon the bare metal. The co-efficient of friction under such circumstances is beyond the range of experience, but the brake efficiency estimated elsewhere would certainly be so great as to make far higher than present speeds admissible for both passenger and freight trains, stopping trains in at most half the distance that is practicable with air brakes. The greater steadiness of motion and less rolling and air resistance would also tend to facilitate higher speeds, so that the claim seems entirely tenable that, as respects mere smoothness and safety of motion, an 80-mile per hour average speed may be maintained as easily as 40 miles per hour is now maintained, to say the least. The three great present obstacles to high speed are (1) and before all others, the oscillation and danger of leaving the rails, (2) the great resistance, and (3) impossibility of getting more than a certain power out of the locomotive without exceeding the admissible loads per wheel. All three of these obstacles are certainly reduced, to their minimum if the theory of the device be made practical on a large scale; and that done, there seems no obstacle but the cost of power to the attainment of such speeds as stated. Possibly the claimed speeds of 120 or 130 miles per hour may be attainable, but we are not yet prepared to regard such as even potentially possible.

If this be so, the commercial advantages of the device which will insure its being pushed into use are to be measured, not alone by the saving of expense, but by the increase of revenue which would result from the higher rates which could be charged. The necessity for much lower freight than passenger speeds would disappear, and freight would be so greatly expedited that—if we may reason at all by comparison of water and rail rates and freight and express rates—nearly double rates could be obtained for freight, as they certainly could be for passenger traffic.

Passing this question, however, and assuming the doubtless costly plant successfully constructed, let us see what effect on running expenses per train might be anticipated. The average present work of a locomotive may be moderately estimated as moving trains continuously against a resistance of about 20 lbs. per ton, this being with passenger trains almost wholly speed and rolling resistance (grades between stations being largely "floated over" by modifications of velocity, and so of small effect); and in freight trains, about 8 lbs. per ton rolling resistance, the remaining 12 lbs. being due to working against a grade of 0.6 per cent. (31 ft. per mile). Even where the locomotive is not actually working against this resistance, the cost is nearly as great as if it were.

To move a heavy passenger train, therefore, there is required 320 x 20 = 6,400 mile-lbs. of work; to move an average freight train, 406 x 20 = 8,120 mile-lbs. To move the corresponding sliding trains, we may take the equivalent resistance for both passenger and freight trains as 13 lbs. per ton, consisting wholly of frictional and air resistance if the train is moving fast enough to float over grades, or of 12 lbs. grade resistance + 1 lb. friction if the train is moving slowly. This gives us only 167 x 13 = 2,170 mile-lbs. for the heavy passenger train against 6,400; and 276 x 13 = 3,588 mile-lbs. for the average freight train against 8,120 lbs., or only 34 and 44 per cent. as much, respectively, with the sliding train.

But in addition to this, the locomotive produces its power uneconomically, burning 4 to 6 lbs. per H. P. hour, against the 2 to 2½ lbs. readily realized in very ordinary stationary engines. It is therefore not unfair to assume that the cost in coal of power realized on the buckets of the sliding train may be only half as great per unit as that developed by the driving wheels, making the cost in coal per train mile only 17 to 22 per cent. as much for the sliding train as now. The French authority from which we quote makes the difference as great as between 420 and 24, or a gain of 94 per cent. in economy, but we cannot follow such hopeful figures.

It is obvious, likewise, that on lines of heavy traffic (which alone we need consider now) the cost of repairs of engines would be enormously reduced, there being only a few stationary engines in place of many locomotives to maintain; that train wages would be reduced from needing no fireman and a less number of brakemen; that repairs of cars would also be very greatly reduced, and that rail wear would be almost eliminated except near stations where brakes were used. This brake wear, moreover, being uniform over the top of a broad rail, would destroy it very slowly. On the other hand, all the station, terminal, and general expenses, and all expenses for maintenance of roadway, ballast, structures, surfacing, etc., may be assumed to remain unchanged.

According to the classification on page 179 of "The Economic Theory of the Location of Railways," these last named expenses amount to 48½ per cent. of the total per train mile. The apparent possible saving in the remaining 51½ per cent. may be estimated as follows, the cost per train mile being taken for convenience at the round figure of $1.00, although it is really about 80 cts.

Items of Expense	*Present cost cts. per tr. m.*		*Possible saving.*	*Resulting cost cts. per tr. m.*
Fuel for engines	7.6	....	say 4-5	1.5
Oil, waste, and water	1.2	....	say 5-6	0.2
Repairs of engines	5.6	....	say 4-5	1.1
Switching engines	3.6	....	say 5-6	0.6
" " wages	1.6	....	say 1-2	0.8
Engine wages	6.4	....	say 1-3	4.2
Car wages	8.5	....	say 1-3	5.7
Car supplies	0.5	....	say 1-2	0.3
Repairs cars	12.0	....	say 2-3*	4.0
Renewals of rails	2.0	....	say 3-4	0.5
Switches, frogs, etc.	2.5	....	say 1-2	1.3
Totals of affected items	51.5			20.2
" unaffected items	48.5			48.5
Total of all items	100.0			68.7

*About 75 per cent. of freight car repairs is for repairs of trucks.

In other words, the cost of handling trains of present length and capacity on a perfected sliding railway is conceivably but little over two-thirds of what it now is, and by taking advantage of the capacity to further increase the length of trains it may be reduced still more. This leaves a large margin to cover interest on the extra first cost of the plant, if any, and the extra expenses for obviating the effects of frost, and of other foreseen and unforeseen obstacles, without considering the higher rates which might probably be obtained.

It is probable, moreover, that such a railway, if perfected, would tend to increase the volume of traffic greatly, as well as the possible rates, and that instead of increasing the length of passenger trains, the more probable tendency would be to decrease their length and multiply their number, this being readily possible by the "sliding" system, if perfected, at slight extra cost, while with locomotives the expense of halving the length and doubling the number of trains is too great to be thought of. This possibility is an enormous advantage for the sliding railway.

There appears, therefore, to be a most wide and promising field for railways of this type, if it can be perfected, and its progress may well be keenly watched. The most obvious immediate field is for "rapid transit" and suburban railways, where the traffic is heavy and speed and comfort great desiderata, and first cost a small consideration. We do not assume or believe that the type is now in condition for wide practical use; it may not be for many years; it possibly may never be: but it is making a good record for itself experimentally, and the principle seems to us a sound one, and ultimately capable of wide practical use.

Government Investigation of Railway Accidents.

When a railway train runs off the track, goes through a bridge, runs into another train, or suffers any of the many accidents to which a railway train in this country is liable, whose business is it to make inquiries? Suppose the accident is a slight one, or even that it is a serious one in which by some good fortune nobody is injured: then we say in this country that it is nobody's business but the railway company's. The débris is cleared away as soon as possible, the broken material goes to the scrap heap, each different department of the company's service tries to lay the blame for the casualty upon some other department, and the hurry and bustle of ordinary business drives the whole affair from everyone's recollection in a week or two.

If the accident involves the injury or death of some person, the case is not very dissimilar. Suits for damages may be presented, and the broad fact whether the company was legally responsible for the disaster may be left for judge and jury to decide. It may be, too, that immediately following the accident a coroner will put in an appearance, and, selecting a parcel of men who know as much of practical railroading as they do of astronomy, will pro-

ceed to determine, for the information and enlightenment of mankind in general, by what means "deceased came to his death."

In a few, a very few, States of the Union, the accident, if it causes death to any person, may be investigated by the State Railroad Commission; and if the accident happens in the Commonwealth of Massachusetts and it is an important one, it may be the subject of a thorough technical investigation by competent experts, who strive to learn all that can be learned from the unfortunate occurrence with a view to the avoidance of similar fatalities in the future.

Good enough this is, as far as it goes; but to learn the most possible from accidents, the statistics of their occurrence and causes should be collected from a much wider range of territory than the limits of a single State. The cause of one great accident which, attracts most attention from its attending fatality, may be an unusual and relatively unimportant matter, while the monotonously frequent "defective switch" for instance, which may cause generally only damage to property, receives little notice from the public even though the total fatalities caused by it may be much greater than those due even to the much and justly maligned car stove.

It is not perhaps generally appreciated among railway men how very different English practice is from our own in the matter of railway accidents. Whether it is on the whole better or not is a question which should be examined with an unbiased mind. Certainly, something or other has so improved in British railway practice that, as we showed in our issue of Sept. 21, the passenger on British railways to-day runs hardly more than one-third the risk of being killed or injured that he did a century ago. It may be well therefore for us to obtain some clear idea of the manner in which our English cousins investigate railway accidents, and the means they take to prevent and diminish them.

The volume before us as a text for these remarks is the returns of accidents and casualties during the six months ending June 30, 1889, as made by the several railway companies in the United Kingdom. By Act of Parliament in 1871 railway companies are obliged to report all accidents occurring on their premises, whether involving deaths or injuries or not, to the Board of Trade. Besides publishing the statistics of these accidents, with their causes, etc., the Board investigates such of the accidents as it deems proper, and publishes the reports of the investigators.

At the outset of the report we come upon the following striking table:

Fatalities and Injuries caused by Accidents to Trains, Rolling Stock and Permanent Way.

	Jan. 1 to June 30, 1889.		Same period in 1889.	
	Killed.	*Injured.*	*Killed.*	*Injured.*
Passengers	81	523	1	255
Employés	—	59	2	50
	81	582	3	305

A jump from 1 passenger killed in six months to 81 passengers killed in the same time, and from 255 passengers injured to 523 passengers injured, gives evidence of the occurrence of some unusual accident. We find it to be the well-remembered disaster on the Great Northern Railway of Ireland, which followed close on the Johnstown disaster in this country last spring, and caused the death of 80 persons and the injury of 260. Had this not occurred, the list of injuries to persons would have been almost exactly the same as last year, 1 killed to 263 injured.

It is to be noted that the above are accidents to passengers from causes wholly beyond their control. By accidents from other causes, such as falling between cars and platforms, getting on or off trains, falling from cars, etc., 32 passengers were killed and 337 injured. The total of casualties to railway employés during the six months was 199 killed and 1,288 injured.

All these statistics are given more clearly and fully than we have space to show here. But the most important and interesting part of the report is that which gives the statistics of the various causes of accident. These we may briefly summarize as follows:

	No. of cases.	*Passengers*		*Employés*	
		Killed.	*Injured.*	*Killed.*	*Injured.*
COLLISIONS	50	80	352	—	43
Pass. trains	17	80	319	—	9
Pass. and f't trains.	18	—	33	—	16
Freight trains	15	—	—	—	18
DERAILMENTS	22	—	82	—	4
Passenger trains	18	—	82	—	3
Freight trains	4	—	—	—	1
ACCIDENTS TO					
Rolling Stock	498	1	75	—	5
Failure of tires	372	—	—	—	—
Failure of axles	118	1	62	—	1
Failure of brakes	1	—	5	—	—
Failure of c'pl'gs	5	—	5	—	—
Failure of locomotives	7	—	3	—	4
BROKEN RAILS	150	—	—	—	—
ACCIDENTS TO PERMANENT WAY	26	—	—	—	—
CATTLE OR OBSTRUCTIONS ON LINE	51	—	—	—	—
TRAINS RUN THROUGH GATES AT LEVEL CROSSINGS	21	—	—	—	—
TRAINS ENTERING STATIONS TOO FAST	11	—	12	—	7

Of the 372 tire failures, 8 were engine tires, 6 were tender tires, 4 were coach tires, 11 were van tires, and 343 were wagon (freight car) tires; 304 tires were made of iron and 67 of steel; 6 tires were fastened by the Mansell method, of which 1 left its wheel on failure; 11 were fastened by Gibson's method, of which 1 left its wheel on failure; 340 were fastened by bolts and rivets and 14 by other methods; 26 tires broke at rivet holes, 1 at the weld, 63 in the solid, and 282 split longitudinally or bulged. Similar full data are given for the axle failures, of which 50 were failures of crank or driving axles. Of the broken rails, 53 were double-headed, 67 were single-headed, and 23 were Vignolles rails. Of the double-headed rails broken, 29 had been turned; 12 of the broken rails were of iron and 137 of steel.

If accident statistics were collected for the whole United States in a similar manner to the above, we should have some idea where the fault lies for the excessive fatalities to railway passengers in this country. We should know also what were the causes producing fatalities so great that they must be remedied at once, and what were the relatively less important causes of accident, for whose remedy we could afford to wait, if necessary.

All the preceding information, however, is given in a few pages. The greater part of the report before us is taken up with the account of the investigation of a dozen accidents only, which were made the subject of special inquiry. The experts making the examination were Col. F. H. RICH, Maj.-Gen. C. S. HUTCHINSON and Maj. F. A. MARINDIN, of the Royal Engineers. For each accident a brief statement is given of the nature of the disaster, then follows a description of the locality and circumstances, the evidence presented, and the conclusions arrived at by the expert. Of the accidents investigated, five are derailments and the remainder are collisions.

It is to be noted that these specially investigated accidents have all occurred during the past three months. For the first three months of the year the report of the 20 special investigations which took place has already been published.

It seems very strange that no special investigation was made by the Board of Trade experts of the fatal disaster on the Great Northern Railway of Ireland, whose roll of killed and injured far exceeds that resulting from all other accidents combined. It is true, indeed, that no expert investigation was needed to place the responsibility for that sad disaster where it belonged; but the impressive lesson which it taught of the dangers which lie in defective brake gear should have been emphasized by some official report.

It is noticeable that in the accidents investigated by the experts no person was killed, and in several cases no persons were injured. The investigations are undertaken, it is evident, with a view to reform improper methods and unsafe appliances, and not especially to fix the blame for a particular accident. It is indeed a noticeable feature, with reference to the work of the Board of Trade, that its powers are almost wholly advisory. The compulsory use of safety appliances, either through legislative enactment or by Board of Trade requirement, is far less common in England than in this country. Indeed, there is a wide belief there that the Board of Trade should be given more power to enforce its recommendations in the case of the few companies which are tardy in complying with them. Whether this is done or not, it is certain that the work of the Board of Trade in inquiring into accidents is of such value to both the railways and the public that neither party would wish it stopped. As we stated at the outset, the remarkable diminution in railway fatalities in Great Britain is the best possible proof that the system, on the whole, has been an advantageous one.

Probably no one will dispute that a similar system of accident reports and investigations, modified as our different conditions might require, would tend toward the safety of the travelling public here. It only remains to be proven that it would be for the best interests of the railway companies themselves.

We are running in a bad rut on this matter. It is esteemed good practice to hide all particulars of accidents in this country from public inspection. There is much excuse for this when the investigation is of that unintelligent sort carried on by the daily press. But let us suppose that a staff of competent Government inspectors should collect statistics of the character and causes of accidents in the several railway districts of this country, giving special attention to the accidents which showed a bad state of practice or the use of improper appliances or material, and should present their conclusions in frequent public reports. The accidents whose weekly occurrence bears sorrow to many homes would then bear some fruit in saving the lives and limbs of those who would otherwise be the future victims.

Much good work of this sort has been done through the railway and professional associations, and by intelligent officers of some of the great systems; but it has been done under difficulties which a Government Board of Inquiry, clothed with power to carefully investigate, would never meet; and its results have been correspondingly inadequate. Such a board would be competent to take up questions which are now pressing upon that greatly overworked body, the Interstate Commerce Commission, and should be able to solve them in a manner satisfactory to both the railways and the public.

American railway practice in many points is unexcelled anywhere. We should not be too prejudiced to try to make it unexcelled in safety as well as comfort, even though to do so we may have in some respects to copy foreign practice.

A BERLIN-BALTIC SHIP CANAL is said to be under discussion in Berlin, with strong business interests enlisted in its support and with the approval of Count VON MOLTKE, who regards it as a strong additional military defence for Germany.

A. of Railway Field Work and Laying Out of Works.*

ACCORDING TO THE MOST RECENT AND APPROVED PRACTICE ON AMERICAN RAILWAYS.

BY A. M. WELLINGTON,
M.Am.Soc.C.E., M.Inst.C.E., etc.

[The author will be pleased to receive typographical or other corrections, or suggestions as to form or substance, from any interested reader. All such suggestions will have full consideration.]

* Publication began in issue of Oct. 12, 1889.

[*Continued from p. 354.*]

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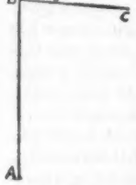
Some particulars in which geometric precision is neglected as unimportant in railway surveys are these:

1. The chaining is not very precise (which is admissible) and is often inexcusably bad.

2. Pluses of less than an even foot, whether for P. C's, P. T's or otherwise, are not usually recognized. It is rarely good practice to set or record a point as at Station 178 + 17.6. It is set and recorded as at 178 + 18. The only exceptions are: (1) when the line is being run through valuable real estate and it is desired to make it an accurate geometric survey; (2) in setting special points for construction purposes; or (3) at times, when a curve is being run in to connect two tangents already precisely defined, which is rather the exception than the rule in good practice.

3. Angles are recorded only to the nearest minute. It is in no case good practice to record central angles of curves, for example, as 40° 38′ 20″ or even 30″, or to run curves of 20° 35′ 30″. The nearest minute only should be read. The only exception is when, as in running a 1° 37′ curve for example, the deflection angle ($\frac{100}{---}$) comes some even fraction of a minute. The fraction is then recorded, to avoid cumulative errors of many half minutes.



4. Deflection angles only are read, and not interior angles. Thus, in continuing a line from B toward C, in any one of the three directions in Fig. 1, the transit at B is first fixed on A, the telescope then reversed, so as to sight on A', and the deflection angle a then measured. This involves a certain sacrifice of exactitude compared with that obtained by measuring the interior angle, but it is the invariable rule in all kinds of railway transit work.

5. Angles are not repeated. The vernier is read once only, as carefully as possible.

6. The transit is not reversed twice in opposite directions as is done in adjusting ($\frac{}{--}$) and the mean of the two points thus fixed taken, but is reversed only once. Unless the instrument be precisely in adjustment, which can only happen by accident, this results in a certain error, but it is small, and is neglected.

7. The station stakes between plugs are not set precisely in line. In good work they should be very nearly on line, if on final location, so that the line will cut some part of their top; but only on the transit points is the line more accurately fixed by a nail or tack.

8. Various approximate formulæ are largely used which facilitate the ready readjustment of curves and tangents to the ground and are sufficiently exact for all practical requirements *within the range required*, although not geometrically exact for all conceivable cases. For example, there are many useful curve formulæ that are almost precisely accurate for dealing with short arcs of the 1° to 10° curves used in practice, which yet would be widely inaccurate for changing a radius from one mile to one foot, for instance. Again, many formulæ are almost precise for making the comparatively minute lateral changes which alone occur in practice, which would be widely inaccurate for throwing a line over 100 or 1,000 ft.

The governing conditions for the proper use of any such approximate formulæ are: (1) that they shall in no case introduce indefiniteness which will impede recovering the line at any time as it was originally located, and (2) that they shall not introduce any important or even appreciable deviations from geometric correctness. Therefore, their proper use requires, not a less but a clearer understanding of the theory of the geometrically exact methods, just as it requires a better topographical knowledge of a region to take a short cut across the fields to a given point than to follow a beaten path, which may be quite unnecessarily indirect.

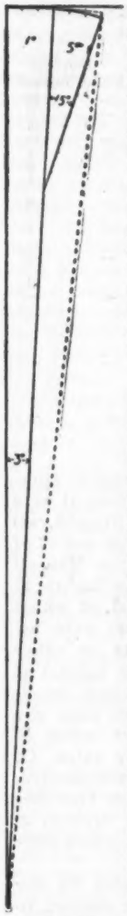


Fig. 2

It is to be remembered, in studying this and all other field-books, that the geometric diagrams are all of them greatly exaggerated. It is indispensable to so exaggerate them in order to have them comprehensible. In Fig. 2 we have the radii and several stations of a compound 1°, 3°, and 6° curve laid off to natural scale. It will be seen at once how impossible it would be to study geometric principles by means of such diagrams. The unavoidable exaggerations of diagrams should not lead us to believe that every method which appears rude on a diagram will in fact be rude upon the ground.

Chaining.—The chain is handled by a head-chainman and rear chainman. A stakeman accompanies the former, with a package of stakes already numbered neatly with red chalk. Numbering each stake as driven is never attempted in good practice, unless exceptionally, as it is sure to lead to error. The head chainman drags the chain, and also carries a transit rod, with which he obtains line from the instrument, holding the chain against it meantime. On obtaining it correctly, he lowers the chain to the ground or to a carefully estimated horizontal line (or should do so), to get the distance more exactly, and then makes a small hole with his rod for driving the stake. The rear chainman then calls off the number of the rear stake at which he stands, the head chainman calls off the next succeeding station, which is yet to be driven, and goes ahead, while the stakeman proceeds to drive it, generally finishing on the arrival of the rear chainman, whose duty it is to note at once that the stake driven is the proper one. If the stakes have been previously numbered, any error is almost sure to be detected, and yet errors will occur, and cause much annoyance.

At a point fixed by his orders or his own judgment, the head chainman holds his transit rod horizontally above his head, in both hands, which is the signal for a transit point. While the transitman is coming up, the chainman goes ahead at least 100 ft., so as to get the chain entirely away from the transit, and if possible will have one stake set beyond it, and the chain stretched beyond that, when the transit is again ready to give line. If woods are encountered, a transit point is at once taken close to, and a few feet into the wood, and then clearing proceeded with while the transit is coming up. In no case should clearing be done while the transit is at a distance. The progress made depends largely on attention to these details.

When the ground is sloping, the chain is held horizontal, and if necessary (as it almost constantly is in many localities) in steps of 10 to 50 ft. at a time. This in fact should be the rule in all cases on sloping ground, as the sag of a heavy chain 100 ft. long greatly shortens it. When chaining in this way, and also in setting all pluses, it should be the invariable rule to first drag the chain ahead for its full length and then to use its successive parts to measure the full distance. Otherwise, error is very apt to occur. The difficulty in this process is to hold the sections of chain level, since a deviation either way shortens the distance laid off, and often materially, so as to cause much trouble later, especially on sharp curves.

Until a student has had training in really accurate measuring, he is rarely able to comprehend how very rude a process ordinary chaining is, and still less how to make it more accurate easily. He will therefore waste time in quite unimportant things, as for instance, getting his exact line, while neglecting to insure that his chain is level. Training in precise measurements, both with chain and tape, is therefore very desirable, but it should be recognized as what it is, training, and not as illustrating practical work. One of the best kinds of training for the latter is running full circles of very sharp curves over rough ground.

A railway line in its simplest form consists of a continuous succession of circular arcs or *curves* and of connecting straight lines *tangent* to the curves and hence termed tangents.

Until recent years all railway lines consisted of these two elements only, but in all good modern practice the curves and tangents do not directly connect with each other at a point, but are connected by *transition curves* of constantly varying radius to ease the shock in passing from one to the other.*

The older form of location is geometrically the simpler, and a correct understanding of it is the necessary preliminary to an understanding of the new and more approved practice. Practically, however, for many reasons, which will be apparent later, the use of connecting transition curves not only gives a better line for the passage of trains, but greatly simplifies the field-work, especially when the curves are frequent and the country at all rough. The two forms of location will be considered separately, the older first.

The point at which a tangent ceases and curve begins is called the *Point of Curve*, or *P. C.* The point where it ends is called the *Point of Tangent*, or *P. T.* The distinction is only for practical convenience. Both are geometrically points of tangency. The point at which the two tangents intersect, if prolonged beyond the P. C. and P. T., is called the *Point of Intersection*, or *P. I.*, or more briefly the *Apex*. Sometimes this point is set in running curves and sometimes not. Ordinarily, in good practice, it is not set, at least until the curve and its connecting tangents have been finally located.

The points of curve are occasionally designated as B. C. (Beginning of Curve) and E. C. (End of Curve). The more usual, and on the whole better, practice is that given.

A curve often terminates in another curve of different radius, curving in the same direction, instead of in a tangent. (Fig. 2.) The two curves together are then called a *compound curve*, and their common tangent point *P. C. C.*, or Point of Compound Curvature. Not unfrequently three or more curves are thus connected into one compound curve.

A curve sometimes terminates in another curve of the same or different radius curving in the opposite direction. The two together are then called a *reversed curve*, and their common tangent point the *P. R. C.*, or *Point of Reversed Curvature*. Reversed curves, in good practice, are only used for turnouts or other short curves over which high speed is never necessary. They are highly objectionable on the open road, and can always be avoided by shortening the radii if not by changing the position of the curves. When transition curves are used, the objection to the curves reversing on a point disappears; and they are freely so laid out when the topography makes it more convenient to do so.

(TO BE CONTINUED.)

CORRESPONDENCE.

The Theory of Transverse Strength.

AUSTIN, Tex., Oct. 10, 1889.

TO THE EDITOR OF ENGINEERING NEWS:

In commenting on my letter in your issue of Oct. 5, I note that you say, "We recognize his right to disprove any scientific principle, however generally it may be accepted, if he can do so by actual experiments or sound logic, but we do not see that he does this in the above article." Actual experiments have repeatedly shown that the *common* theory absolutely fails to establish any relation between the breaking strength of a beam and the compressive and tensile strength of the material of which it is made, while the *same experiments* show that the theory proposed by me does establish this relation both for beams and columns; but as this evidence is *fully* and *fairly* given in the book under discussion, it was not deemed necessary to repeat it.

*For the reason why they are demanded see Ec. Th. Loc. Ry. p. 275, 809.

You say, of a beam that is supported in the middle and loaded at its ends, "conceive one-half of the beam and its load to be removed, and to maintain the same equilibrium substitute from a *foreign source* the applied forces ($-T$ and $\times C$) that are equal to the resultants of the distributed horizontal *components* of the removed load." Now I claim that this substitution entirely eliminates the effect of the removed load and makes it simply a beam *fixed at one end and loaded at the other*, as in Fig. 1, in this I am sustained by that eminent authority Prof. RANKINE. The beam Fig. 1, being fixed at one end, can be broken by the load L, just as if it were fastened in a wall, and when the rigid *resistance* is overcome, the beam bends and *develops* the *horizontal components* of the load, that must be equal and opposite to our applied forces. Hence our conditions of equilibrim for *strength* must be deduced from the diagram in Fig. 2, and not from the pure *static* diagram in Fig. 1. In the *whole* beam, we have no *control* over the *horizontal components* ($-C, +T$) *developed* by the load, therefore we must *conceive* the forces $-T$ and $+C$ to be *applied simultaneously* with the development of $-C$ and $+T$ and there can be no motion, as *numerically* we have $+C = -C$ and $+T = -T$ and it is a mechanical absurdity to *arbitrarily* make $C = T$ to prevent horizontal *traveling*. The loads L, on the ends, *each developes two horizontal components*, that fully take the places of the loads, therefore the loads L must balance each other through the balancing of their horizontal components. The common theory is deduced from the absurd condition of making the load L Fig. 1, *directly* balance the components of another load L ($-T$ and $+C$) and at the same time, in the *whole* beam, it *must develop* two equal components of its own ($-C$ and $+T$) as in Fig. 2, *Directly* doing these two things at the same time is impossible. Prof. DUBOIS practically says, if we do not make $C = T$ in Fig. 1, the half beam will *travel*, that is if we have T greater than C, it will *travel* to the *right*, but as exactly like conditions must exist in the other half of the beam, its T force will *travel* to the *left*, and as one-half of the beam cannot *travel* without the other, we will have the whole beam moving in *opposite* directions at the same time. In this connection we must not confound the *movements* of the *particles*, with the *traveling* of the beam, as they are entirely distinct motions. If the half beam can *travel* at all, it can do so *indefinitely*, therefore the "ludicrous consequences" of this "lucid theory" is not "nonsense;" for you must either accept the results from not making $C = T$ or deny that the equilibrium of the half beam in Fig. 1 is its equilibrium when it forms a part of the whole beam, or when its *halves* are put together. Whichever horn of this *dilemma* you take, it will destroy your argument.

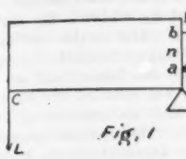


Fig. 1

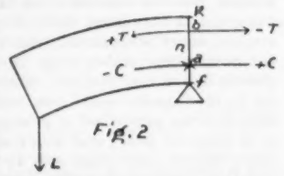


Fig. 2

He also says that in the *whole* beam we must make $C = T$. The *fallacy* of the statement was shown by pointing out the ridiculous and impossible consequences that would follow from our conceiving T not to be equal to C, and that therefore it is unscientific and illogical to apply a condition to prevent the occurrence of an impossible thing. The *reductio ad absurdum* is a legitimate and often used form of argument to prove or disprove a statement.

In the discussion of the correctness of a mechanical principle I am astonished to find you use the expression that you "fail to see how the theory proposed by me is superior in clearness or simplicity to the old." If this was all to be desired, the old could be improved.

Mr. Editor, you say the theory proposed by me is wrong because the old is right, and cite me to the argument that sustains your position. This I have shown is not applicable to the case. Having made the attack, as ably edited a journal as the ENGINEERING NEWS should either distinctly show the fallacy of the argument in my reply, or else acknowledge that its criticism was made upon false premises, and not content itself with such vague expressions as "fail to see," "peculiar theory," etc., for if a fallacy exists it can be found.

R. H. COUSINS.

[Mr. COUSINS' chief contention, which he makes somewhat more plain in this article, is in brief that in a bent beam the sum of the tensile forces is not necessarily equal to the sum of the compressive forces, but that the sum of the moments of the tensile forces is equal to the sum of the moments of the compressive forces. If any of our readers wish to see further discussion of the subject, they can doubtless find enough to satisfy them in Volumes XVIII and XIX of this journal. At the present time, as a large proportion of our readers have probably no interest in the subject, and as we have given Mr. COUSINS ample space in which to defend his position, we think there is no necessity of continuing the controversy further.—ED. ENG. NEWS.]

Underground Air for Cooling Buildings.

BOWLING GREEN KY., Oct. 7, 1889.

TO THE EDITOR OF ENGINEERING NEWS:

In reading your issue of Oct. 5, in one of the editorials you speak of a lofty building with immense elevators. In this connection I wish to submit a question, as to the use of elevators. As the General Manager of the Grand Avenue Cave Hotel Co., I am sinking a shaft into the cave which will be about 150 ft. deep, with the intention of securing cool, pure, dry air to ventilate and cool the rooms of the hotel, which will be erected over the cave. I also purpose putting in an elevator to carry persons from the building into the cave below, if the latter be practicable. You speak of elevator lifts, 250 ft. high. Mine would not exceed 150 ft. I should also like the opinion of ventilating engineers upon the conduct of the air in the cave, and that in the cellar of a large building with a shaft, say, 4 ft. × 6 ft. connecting the two. The temperature of the cave is 55° the year round. Will it not mingle with that of the cellar, until the temperature of the two becomes the same? In other words will not the hotel simply become the upper story of the cave? I have not been able to get anything in the way of information upon the feasibility of this rather novel plan of using the cave air for making people comfortable in the sweltering months of summer. I contend that it may be done, as heated air is used in winter. To this end I am putting down a 6-in. shaft, to which will be attached a No. 3 Monogram (Sturtevant Fan) and over the hole a 4 room house will be constructed, and a thorough test will be made as to the handling of the air, I should like suggestions as to how this test can be made most effective. The Palace of the Trocadero, Paris, is cooled with air taken from the stone quarries. I have 5 miles of cave, which will average 40 ft. wide and 60 ft. high, from which to get air. The shaft is located 1,200 ft. from the entrance to the cave. I think a number of interesting scientific questions will arise during the test, which will be made during the next 30 days.

M. H. CRUMP,
City Engr. and Gen'l Man. Grand Ave. Cave Hotel Co.

[The scheme which our correspondent has in view is a decidedly novel one. He will certainly find it necessary to use a blower to raise the cool and heavy air of the cave up a 150 ft. shaft and into his hotel. The best success would probably be attained if the air were forced from the cave to the top story of the hotel, and allowed to pass downward to the various rooms as the guests desired. What the effect of cave air would be upon a person continually breathing it, we will not venture to say. Perhaps it will engender a disposition to return to the primitive habits of the cave-dwellers of prehistoric times. As to the use of elevators of 150 ft. lift, there is no difficulty whatever. The extreme travel of elevators in some of the highest office buildings in this city approaches close to that distance. ED.—ENG. NEWS.]

Asphalt Paving in Munich.

MUNICH, Oct. 9, 1889.

TO THE EDITOR OF ENGINEERING NEWS:—

As the subject of street paving is always interesting, I send you a few notes on German paving methods, not because they are novel, but simply as showing the practice in this part of Europe.

The pavement now under construction here is the "asphalte comprimé," or the *Sicilianische Asphalt pflaster*. It is being laid by the Kupp Asphalt Co., of Berlin, in which city the same firm has already laid over 600,000 sq. m. of the same pavement. Sicilian asphalt, from the Ragusa quarries, is alone used by this company; the character of this asphalt is well known in the United States and further description is unnecessary here.

The street is excavated to the proper depth and leveled, and the beton is then put down. This beton is made of one ton of cement to one cubic metre of clean gravel; the cement and gravel being first thoroughly mixed in a dry state, and then wet and again mixed. The former Berlin practice was to make this bed of beton 17 cm. (6.6 ins.) thick, but this has been increased to 20 cm. (7.8 ins.) within the last few years. In Paris the beton is only from 10 to 15 cm. (3.9 to 4.9 ins.) thick, and this is given as one reason why the pavements there are not as good as those of Berlin and London. In these latter cities the beton base ranges in thickness from 5 ins. to 9 ins., according to the nature of the underlying soil.

In Munich, the beton bed requires from 8 to 10 days, according to the season and weather, to properly set. The asphalt which is to cover the beton is delivered ground to a very fine powder, and is heated in large pans to a temperature ranging between 120° and 160° C. It is then loaded into carts, which can be tightly closed or covered if the point of use lies at any considerable distance from the heating pans. If the work is near at hand, barrows are commonly used.

This heated asphalt powder is then spread over the beton surface in layers as uniform in thickness as possible and about 40 per cent. thicker than the intended sheet of finished asphalt. All leaves and other foreign matter must be carefully removed from the beton surface before the asphalt is put down, otherwise holes will appear in time. As soon as it is carefully levelled, the asphalt is ready for ramming and rolling. First, all the parts adjoining the curbs or the completed pavement are rammed with a so-called *Fugen-eisen*; this is a bar of iron about 2 ins. broad and thick and 8 ins. long, and like all the other tools used in compressing the asphalt, it is made hot in an open grate.

As soon as the marginal parts are completed, ten or more men ram the entire surface with rammers with a circular base and weighing about 55 lbs., each. This ramming is preparatory to the passage over the surface of rollers which weigh from 400 to 900 kilos. (880 to 1980 lbs.) each. In the interior of each roller a small grate is arranged for burning coke, so as to keep the surface of the roller heated. After the rollers have gone over it, the surface is again rammed with the circular rammers to smooth out any inequalities.

The last operation is the "ironing," which is done with a curved iron bar, weighing about 55 lbs., and fastened to a long handle. This bar is polished on the under surface, and is heated and drawn back and forth over the entire pavement, giving it a high degree of smoothness and filling all small holes and pores. In a few hours after this final ironing the asphalt pavement is ready for traffic. The final thickness of the asphalt sheet varies, with the amount of traffic on the street, from 4 to 5 cm. or 1.57 to 1.96 ins. All repairs are made at night. The company is now laying from 400 to 500 sq. m., or from 478 to 598 sq. yds., per day. Under an exceptional rush it at one time put down 800 sq. m., or 957 sq. yds., per day. Yours truly, HENRY MELCHERS, JR.
Student of Engineering.

The Turbine Problem.

ROCHESTER, N. Y., Oct. 5, 1889.

TO THE EDITOR OF ENGINEERING NEWS:—

In reference to the turbine problem discussed in several recent numbers of ENGINEERING NEWS, the following solution is here submitted. The problem is to find the greatest power which can be obtained through a pipe of given diameter (20 ins.) with a given head or fall (800 ft.), and it may be solved as follows in a perfectly general manner for all similar cases.

With the notation:

h_1 = friction head required for the given pipe, in feet;
H = total fall or head, in feet (here given as 800 ft.);
$h_2 = H - h_1$ = fall available for power in feet;
d = diameter of pipe, in feet (here given as 20 ins.);
l = length of pipe, in feet;
Q = discharge of pipe, in cubic ft. per second;
N = Theoretical horse-power resulting from the fall of (Q) through height (h_2), we shall have

$$h_1 = \alpha \cdot \frac{l}{d} \cdot v^2 ; \quad \ldots \quad (1)$$

$$v = \sqrt{\frac{h_1 d}{\alpha l}} ; \quad \ldots \quad (2)$$

$$Q = \frac{\pi d^2}{4} v = \frac{\pi}{4\sqrt{\alpha}} \sqrt{\frac{h_1 d^5}{l}} = \beta \sqrt{\frac{h_1 d^5}{l}} . \quad (3)$$

and

$$N = \frac{62.4\, Q h_2}{550} = \gamma Q h_2 = \gamma \beta \sqrt{\frac{h_1 d^5}{l}} (H - h_1) . \quad (4)$$

Now in the problem presented, the diameter (d), length (l), total fall (H), and coefficients (γ and β) are all known, so that Equation 4 contains only the two unknown quantities (N) and (h_1), and may be written as follows:

$$N = \gamma \beta \sqrt{\frac{d^5}{l}} (H h_1^{\frac{1}{2}} - h_1^{\frac{3}{2}}) = c (H h_1^{\frac{1}{2}} - h_1^{\frac{3}{2}}) \quad (5)$$

By differentiating and placing the first differential coefficient equal to zero, in order to find the value of (h_1) which will make (N) a maximum, we obtain:

$$\frac{dN}{dh_1} = c \left(\frac{H}{2\sqrt{h_1}} - \frac{3}{2}\sqrt{h_1} \right) \quad \text{hence} \quad (6)$$

$$H = 3h_1 \text{ or } h_1 = \frac{H}{3}.$$

It will then be seen that in order to secure the greatest power, the friction head (h_1) should be one-third o

the total head (H); or in the particular case given, (h_1) should be $= \frac{800}{3} = 267$ ft.

To find the corresponding velocity (v) and discharge (Q) of the pipe whose diameter is (d), the length (l) must be known, whereupon these elements will be found from Equations 2 and 3 above; and if we assume this length at $l = 2\ H = 1600$ ft., and take the value of α from Darcy's formula, viz., $(\alpha) = 0.0003869$, there follows:

$$v = \sqrt{\frac{h_1\ d}{\alpha\ l}} = 26.812 \text{ ft. per second:}$$

$$Q = \frac{\pi\ d^2}{4}\ v = 58.494 \text{ cu. ft. per second; and finally}$$

$$N = \frac{62.4\ Q\ h^2}{550} = 3537.2 \text{ Horse power theoretical,}$$

under the assumed conditions.

The main point to be brought out by the foregoing demonstration is the fact that in the development of the greatest amount of power, *one-third* of the total fall (H) should be consumed in overcoming the resistance of the conduit or channel which conveys the requisite volume of water to the motor. It may also be remarked that the same relation holds true when the water is conveyed in an open channel, instead of a pipe under pressure.

Yours very truly,

EMIL KUICHLING, *M. Am. Soc. C. E.*

Notes and Queries.

H. L. V. can obtain the use of a copy of GEO. ESCOL SELLEN'S pamphlet on inclined railways, inquired after in our issue of Oct. 5., by addressing SAMUEL MCELROY, C. E., 50 Johnson St., Brooklyn, N. Y.

Mr. MORRIS SELLERS, 6 Ashland Block, Chicago, Ill. writes that he also has a valued copy of the desired pamphlet, which can be consulted on application.

L. Y. S. asks: "Do you know of the existence of a map showing the progress of railroad building in the U. S from earliest times to the present? Something, for example, which will show the progress by decades. If such has ever been made, I would be under many obligations if you would indicate where it could be obtained or seen.'

April 27, 1889, this journal published a diagram giving this information by sections. If there has ever been any such map prepared as is asked for above, we do not know of it. If it exists, we should be glad to be referred to it.

J. H. H. There are various tables in print for turning areas in square feet into "end area" cubic yards, and one or two precisely like the sample that you send of volumes for the sum of the two end areas without dividing them by two. The last form is the best; but we do not think there is room for further tables of the kind. The best, quickest and most accurate way of computing such volume is by Mr. WELLINGTON'S diagram (1 vol. and portfolio of plates, $3.50) by which the area is given already multiplied by $\frac{1}{27}$, so that the mere summation of the diagram readings gives the end area volume in cubic yards to the nearest yard, a simple "prismoidal correction" being applied later to those solids which need it.

W. M. Durham, N. C., writes: I see on page 324 of ENGINEERING NEWS of Oct. 5, 1889 a substitute for the block system mentioned "known as the train staff system," Can you tell me how to get a description of this system?

Barry's "Railway Appliances" (D. Appleton & Co., 1876, $1.00) contains a brief but good description of the system and of block signalling generally. It has been, however, considerably expanded from its elementary form, and various patent train staffs have been designed and used to enable two, three or more trains to pass in the same direction before one returns. The Wise train staff was described and illustrated in ENGINEERING NEWS, June 23, 1888, p. 510. Various British reports of the Board of Trade contain further details.

F. H. S. asks: 1. Have you any work on hydraulic cement that will give me information on laying artificial stone pavement? 2. Can Portland and Rosendale cements be mixed so as to obtain good results? 3. What proportions, etc? 4. Will frost affect Rosendale cement more than Portland? I have Gen. GILMORE'S work, but do not find in it just the information I am in need of, and not knowing of any place to obtain it but at your office, I write you in hope of your being able to enlighten me on the subject.

1. If by "artificial stone pavement" sidewalks are meant, we do not know of any work specially devoted to pavement construction; but GILMORE on Lime and Cements, and a little work in the Weale's Series, by Mr. FALIA on Portland Cement Work, should contain all the information really wanted. 2. Yes; see the report of Am. Soc. C. E. committee on Cement Tests and the results of such mixing on the Boston Improved Sewerage Works. 3. Consult Baker's new Treatise on Masonry Construction, an admirable work, price $5. 4. Rosendale is much more affected by frost than Portland.

J. W. W. Parson's "Track," $2.00, contains much of the information you wish. Apply also to Ramapo works, Union Switch & Signal Co., etc., for catalogues.

R. S. P. asks us for the address of the manufacturers of luminous paint referred to in our issue of 12th inst., which we are unable to give. Any reader aware of it is requested to inform us.

The Judson System of Car Propulsion.

An illustrated description of this novel system of propelling cars on street or elevated roads was given in our issue of July 13. During the past summer the company controlling the patents has been making exhaustive experiments with full-size car and plant at the works of the Ingersoll-Sergeant Rock Drill Co., in this city. The experimental track was only 206 ft. long, but it had four curves of 20 ft. radius and two grades of 10 and 12½ per cent. respectively, and the speed made was nine miles per hour, so that for testing purposes it was much more severe than any case likely to be found in practice.

The system requires considerable plant in the motive power, and the first objection that is naturally made against it is the first cost of installation. To meet this objection, the owners present the following comparative statements of cost of construction and operation. The estimated cost of constructing six miles of double track, including 60 cars and all necessary machinery, but excluding real estate and buildings.

By Julien System		$ 491,500
Cable	"	1,076,000
Horse	"	259,620
Judson	"	702,000

The estimated cost of operating the above systems, including interest on investment at 6 per cent, is given as follows:

By Julien System	5.3	cts.	per car	per mile,
Cable "	8.9	"	"	"
Horse "	9.8	"	"	"
Judson "	2.7	"	"	"

The above figures are based on a 14-hour run by the Julien; and 18-hour by the cable and Judson systems, and assuming that the Julien cars average 6 miles per hour, the cable, 4¾ miles, and the horse-car, 60 miles per day and 9 horses to a car. The Judson Co. claims 6 miles per hour because of the saving in time in starting and stopping possible with this machine.

The claim is made that even the above figures can be greatly reduced, as in this estimate it is assumed that only 33⅓ per cent. of the power generated at the central station is utilized, while in France and England, by a simple reheating device, an efficiency of 84 to 86.9 per cent. has absolutely been obtained. The company is working in a similar direction and expects shortly to demonstrate that Americans are not behind the countries named in the transmission of power by compressed air.

The cost of power-plant for a six-mile double-track line is given for the various systems as follows:—

By Julien System		$ 77,500
Cable	"	104,000
Horse	" including only horses and harness	85,620
Judson	" as per guarantee of the Ingersoll-Sergeant Rock Drill Co	25,000

The official address of the Judson Pneumatic Street Railway Co. is Aldrich Court, 45 Broadway, New York City, and any further inquiries concerning this ingenious device should be addressed to the company.

James Prescott Joule.

The debt of modern science to JAMES PRESCOTT JOULE, whose death at the age of 71 the cable dispatches last week reported, is far greater than is commonly known. Mr. JOULE is chiefly known to the world from his quantitative determination of the mechanical equivalent of heat; but his great work was not the mere carefully conducted physical measurement which determined the relation between two forms of energy. He was not only a careful experimenter, but a profound observer and reasoner, and the theory of the conservation of energy, on which modern science is based, owes to him, more than to any other person, its thorough proof and its transfer from the field of speculation to the domain of accepted scientific fact.

The generally accepted notion of heat in the early days of modern science was that heat was a subtle elastic fluid, pervading all matter through minute pores and interstices. The modern theory, that heat is merely a mode of motion of the minute particles of which all matter is supposed to be composed, was also considered by early scientists. BACON in his "Novum Organum" stated his belief that heat consists of a kind of "brisk agitation" of the particles of matter, and Sir ISAAC NEWTON is now known to have had some correct understanding of the correlation of energy, as far as purely mechanical matters were concerned.

Near the close of the last century, BENJAMIN THOMPSON, Count RUMFORD, made some interesting experiments in the production of heat by friction, making a blunt tool set in a lathe rotate against a metallic surface surrounded by water. By this method he brought 19 lbs. of water to the boiling point after two horses had turned the lathe for 2½ hours, and he concluded that one horse could generate heat as rapidly as nine wax candles. Sir HUMPHRY DAVY in 1799 performed his experiment of melting two pieces of ice by rubbing them against each other; but neither of these observers fully grasped the fact that these experiments completely disproved the materialistic theory of the nature of heat and established the convertibility of heat and mechanical motion.

This will appear less strange when we consider the slowness with which the scientific world at large accepts theories contradicting those to which it has given its adherence. Both RUMFORD and DAVY stopped short of deducing from their experiments the conclusions which seem in the light of the present day so very obvious. The former was misled by the "specific heat" test, which the materialistic doctrine prescribed to determine the capacity of a body for heat; and DAVY stumbled over the same obstacle, and came only to the weak conclusion that "friction does not diminish the capacity of a body for heat."

JAMES PRESCOTT JOULE was born at Salford in 1818, and was educated under private teachers. He was for some time a pupil of JOHN DALTON, the famous chemist to whom we owe the atomic theory. JOULE'S earliest work in original research was in electro-magnetism, which he proposed to apply as a motive power. In 1840 he announced the important law that the attractive force of two electro-magnets is proportional to the square of the strength of the magnetizing current. About this time his attention was turned to the study of the nature of heat. The materialistic theory was still the generally accepted one, as no one had yet been acute enough to deduce the correct meaning of the experiments of DAVY and RUMFORD, performed a half century before. JOULE began with the production of heat by voltaic electricity, and proved conclusively that some relation existed between heat and chemical affinity. About the same time the brilliant young German physicist, ROBERT MAYER, engaged in the same researches to prove the correlation of heat and mechanical work; and a long and bitter dispute arose between the two scientists as to which was the original discoverer. MAYER excelled in the field of speculation, and propounded his new theories with much brilliancy, though in a somewhat crude form. JOULE worked by careful and accurate physical experiments, and proved the theory of the conservation and correlation of energy so plainly and completely that it was at once accepted without question by the scientific world.

This theory holds that energy, in whatever form it exists, is indestructible, and that the production of any form of energy, whether it be heat or light, chemical, electrical or mechanical action, can only be accomplished by the expenditure of some other form of energy, in amount just equal to the amount produced.

The best known of JOULE'S experiments is that by which he determined that the mechanical equivalent of the heat required to warm 1 lb. of water at a temperature of 60° Fahr., 1°, is equivalent to the mechanical energy required to lift 1 lb., weighed in a vacuum at the latitude of Manchester a distance of 772 ft. The apparatus for this experiment consisted of a shaft, carrying four paddles revolving in a cylindrical vessel filled with water, which was prevented from rotating by fixed vanes. The paddle shaft was driven by falling weights attached to cords wound upon the shaft, and corrections were applied for the source of loss from radiation, from friction of the shaft, from the Kinetic energy of the falling weight when arrested, the buoyant effect of he atmosphere on the falling weights, etc. Other less accurate methods of determining the mechanical equivalent were made on compressed and expanded

air, and also on cast-iron discs rotated in a mercury bath.

As an instance of the painstaking accuracy with which his experiments were conducted, it is said that in the latter experiment a loud noise was produced, corresponding of course to a loss of energy. Dr. JOULE therefore endeavored to determine the amount of energy required to produce an equal amount of sound from the string of a violoncello and to apply a corresponding correction.

The final determination by JOULE, made during the years 1870-77, showed that 772.43 ft. lbs., measured at the latitude of Manchester, is the mechanical energy corresponding to the heat energy required to raise the temperature of 1 lb. of water weighed in a vacuum from 60° to 61° Fahr.

Mr. JOULE received many medals and degrees of honor from the British learned societies, and the results of his researches are mostly contained in the proceedings of these organizations. He wrote little or nothing concerning his work in a popular form; and it is largely for this reason that this work is less widely known and appreciated than its importance deserves among the practical men whom he did so much to benefit.

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

Boston & Albany.—The annual report of this company for the year ending June 30, 1889, gives the following results of operations:

Gross earnings	$6,528,934.02
Operating expenses	4,657,886.70
Net earnings	$1,871,097.32

The rolling stock now consists of 251 locomotives, 6,854 cars of all kinds, and 12 snow-plows. President BLISS considers that the present law in regard to the abolition of grade crossings in Massachusetts should be simplified, as in its present condition it is only with great difficulty that the work can be accomplished.

New York & New England.—The annual report of this company for the year ending June 30, 1889, shows as follows:

Gross earnings	$5,497,398.73
Operating expenses	3,660,447.42
Net earnings	$1,836,951.31

Central R. R. of New Jersey.—Efforts are being made by the people of Chestertown, Md., to induce the Baltimore & Delaware Bay R. R., to build an extension from its present terminus on the outskirts of Chestertown through that place to a point on the Chester River, a distance of about 1 mile.

Indianapolis & Vincennes.—Work on the branch from Gosport to Elletsville, Ind., 8 miles, is progressing rapidly. It is announced that it will be completed and opened for traffic by Jan. 1, 1890.

Toledo, Columbus & Cincinnati.—Tracklaying will commence soon on this line between Findlay and Kenton, Ohio.

Maine Central.—It is stated that this company has purchased the Somerset R. R. running from Oakland to North Anson, Me., 25 miles, paying $300,000 and assuming the cost of extension to Bingham, Me.——It is also announced that this company will provide the capital for the construction of the Shore Line R. R. from Mt. Desert Ferry to Calais, Me.

Philadelphia & Reading.—A press dispatch from Sea Isle City, N. J., states that there is every indication that the line from Winslow Junction to Cape May, 35 miles, will be pushed rapidly to completion. The ties and rails have been purchased, and a force of men is at work near Tuckahoe clearing and building the road-bed.

Beech Creek.—It is stated that the officials of this road are examining the ground preparatory to an extension of the road from Jersey Shore to Williamsport, Pa., a distance of about 12 miles.

Manistee & Northeastern.—J. J. HUBBELL, of Manistee, Mich., Chief Engineer, writes us that about 100 men are now at work on the extension of this road from Lemon Lake north to Traverse City. About 4 miles of track have been laid from Lemon Lake to Copemish, Mich., and the grading is in progress on 17 miles more from Copemish to Section 16, T. 26 N. The surveys for the further extension of the road will be made this month. The principal business will be in farm produce and timber.

Cumberland Valley.—It is stated that this company is considering an extension of the South Penn. branch into Huntingdon or Bedford County, Pa.

Toledo & South Haven.—This road, running from Lawton to South Haven, Mich., 37 miles, is to be changed to standard gauge and extended from Lawton south.

Concord.—The preliminary survey for the second section of the Suncook Valley extension, from Barnstead Center to the Gelmanton Iron Works, a distance of 6.47 miles, has been completed. There is a total rise of 114.34 ft. in the entire distance.

Projects and Surveys.

Rockland, Rockport & Camden.—W. T. COBB, of Rockland, Me., President, writes us that this road is projected to run from Rockland, via Rockport, to Camden, a distance of 9 miles. The surveys have been completed and the road is now being bonded. Construction will commence early next spring if satisfactory aid can be secured.

Detroit & St. Clair River.—Contracts will be let soon for building this 43 miles Michigan road. C. E. MCELROY, of St. Clair, Mich., is President.

Georges Valley.—At a meeting of the stockholders of this company recently held the following officers were elected: President, Q. C. THURSTON; Secretary, BENJ. BURTON; Treasurer, O A. BURKETT; and directors, F. A. ALDEN, A. F. BROWN, JASON BOBBINS, E. L. THOMPSON, E. H. BURKETT, Q. C. THURSTON, and BENJ. BURTON.

Palisades.—It is announced that work will soon begin on the construction of this road. The road will start from the Weehawken Station of the West Shore R. R., running to the top of the Palisades and along the ridge to Alpine, N. J. The grade necessary to reach the top of the ridge will be above 100 ft. per mile. The officers are: W. S. OPDYKE, President and WM. S. COE, Treasurer.

Mt. Moosilauke.—The officers of this company, which proposes to build a line of railway up Mt. Moosilauke, N. H., are: JOHN H. PEARSON, President; S. B. PAGE, Clerk; and Directors HIRAM TURNER, C. A. BUSIEL, WARREN T. DANIEL, IRA WHITCER, and EZRA B. MANN.

Westerly & Jewett City.—Chief Engineer THOS. F. CHAPPELL, of Pawtucket, R. I., has completed the survey for this 25-mile railway from Westerly, R. I., to Jewett City, Conn. There is a prospect that the road will be extended to Watch Hill, Conn.

Connecticut.—A press dispatch from Jewett City, Conn., states that there is a movement on foot to secure a road by Rockville, R. I., and extend it up through the Tomaquay Valley, to tap the New England road at a point at or near Plainfield. The road will develop a rich section of country in Connecticut, and be of great benefit to the several factories along the proposed route.

McKeesport & Bessemer.—It is announced that this Pennsylvania company has purchased $115,000 worth of real estate in McKeesport, Pa., on which extensive yards and side tracks will be made. This line will connect Carnegie's works with the McKeesport & Belle Vernon R. R. A new bridge will be built at Reynoldton.

Essex Construction Co.—This company has been incorporated in New Jersey by J. THOMAS BUDD, of Newark, N. J., JOHN C. KILBRAITH and T. H. P. FARR, of New York, to build and equip railways.

Delaware & North River.—The surveys for this road, which is to run from Summitville to Kingston, N. Y., have been completed, and the engineers are now at work on a branch from High Bridge, via Rosendale and Springtown, to the Poughkeepsie Bridge.

SOUTHERN.—Existing Roads

Ohio & Big Sandy.—It is announced that construction will soon begin on the extension of this road, formerly the Chattaroi R. R. The extension will run from Richardson, Ky., to a connection with the Norfolk & Western R. R. at Pocahontas, Va., a distance of 135 miles. The locating survey has been completed. The route is up the Big Sandy Valley, crossing the Cumberland Mountains at the Breaks of Sandy, and running from there in an almost direct line to Pocahontas.

Louisville, New Albany & Chicago.—This company has completed negotiations by which it has secured a through route from Louisville to Lexington, Ky. The company has leased the newly completed branch of the Louisville Southern R. R., running from Lawrenceburg to Lexington, Ky., a distance of 24 miles, for a period of 30 years. The Versailles & Midway R. R., running from Versailles to Georgetown, Ky., has also been secured.

Louisville, New Orleans & Texas.—The line running from Rosedale to Coahoma, Miss., 50½ miles, has been completed and will be opened for traffic soon. This line, together with the Lake Washington branch, which has been extended from Hampton to Rolling Fork, 10½ miles, this year, and that portion of the Arkansas City branch from Lamont to Willezinski, will hereafter be known as the Riverside Division of the L., N. O. & T. R. R.

Cincinnati, New Orleans & Texas.—It is stated that this company is considering the building of a branch from Rockwood to Athens, Tenn., a distance of about 30 miles.

Alabama Midland.—The locating survey of the Montgomery, Tuscaloosa & Memphis R. R. running from Montgomery to Tuscaloosa, Ala., has been completed. A very favorable route is reported to have been secured.

Richmond & Danville.—The Murphy branch of the Western North Carolina R. R. has been opened for traffic to Westfield, N. C., 18 miles north of Murphy, N. C. Work is being pushed on the remainder of the line and the road will be completed in a few months.

Norfolk & Western.—The surveys for the 6-mile branch from Salem, Va., to the iron mines of the Salem Furnace Co. have been completed, and construction will commence at once.

Owensboro, Falls of Rough & Green River.—R. S. TRIPLETT, of Owensboro, Ky., has furnished us with the following data:

The road runs from Owensboro, Ky., southeast, via Philpot, Whitesville, and Fordsville, to Falls of Rough, 40 miles. About 30 miles of the road have been completed and opened for traffic. Work is being pushed on the remainder of the line by a force of 200 men. The road passes through a country rich in minerals, and a large business is expected in coal, iron, limestone, sandstone and fire and potter's clay. A large traffic will also be obtained in timber, agricultural produce, and general merchandise. Shaefer & Nichols have the contract for building the road. The enterprise was originated and carried through by Owensboro capitalists.

Projects and Surveys.

Ohio & West Virginia Southern.—WM. M. MORSE, of Marietta, O., Vice-President, has given us the following data concerning this enterprise:

The road is to run from Marietta, O., southeast via Willow Island, Cornwallis, Harrisville and Glenville, to Braxton, W. Va., a distance of about 75 miles. The route is through a fine mineral, timber and grazing region, affording easy grades and curves. The principal business of the road will be in timber, coal, coke, iron, live stock and general merchandise. The object of the line is to open up the mineral fields and timber lands of central West Virginia, and to establish a connection between the railways of that State and the lines running west from Marietta. Considerable progress has been made in securing right of way, and a large amount of local aid is expected. T. W. MOORE, of Marietta, O., is President.

Atlanta, Asheville & Baltimore.—President NATT ATKINSON, of Asheville, N. C., is reported as saying that a syndicate of New York capitalists has entered into a contract to construct this line of railway, which is projected to run from Atlanta, Ga., northwest to Roanoke, Va., and that a survey will be commenced at once.

Fernandina, Jacksonville & St. Augustine Ship Canal & Transportation Co.—This company has been organized in Florida for the purpose of building and operating a ship canal from Fernandina to Jacksonville, Fla., about 25 miles, and for constructing a line of railway from Jacksonville to St. Augustine, Fla.

Decatur Belt.—A company has been formed to build a belt line of railway around the city of Decatur, Ala. It is thought that work will begin at once.

Atlanta & Lithonia.—This company, recently incorporated in Georgia, proposes to build a railway from Atlanta via Decatur and Stone Mountain to Lithonia, Ga.

Danville, Mebane, Pittsboro & Southern.—This company proposes to build a railway from Danville, Va., through the counties of Caswell, Alamance, Orange and Chatham, to a connection with the Seaboard Air Line system.

Mount Pleasant & Seaview City.—The surveys have been completed for this South Carolina road, and as soon as arrangements for beginning work can be made construction will be commenced and the road pushed rapidly to completion.

Birmingham, Jackson & Kansas City.—It is stated that this company has entered into a contract with C. P. HUNTINGTON whereby, in consideration of $175,000 he will build the line from Jackson to Dyersburg, Tenn. It is thought that the required amount of money can be raised and that work will soon commence on the road.

Virginia Western.—A correspondent writes us that this project is now at a stand still. Surveys were made two years ago under the direction of the Chief Engineer, H. D. WHITCOMB, of Richmond, Va. The route will probably be from Lexington, Va., southwest to the State line at Bristol, Tenn. The route is through a country rich in minerals and containing good farming lands. If the road is built the probability is that it will be a southern extension of the valley branch of the Baltimore & Ohio R. R.

Augusta & West Florida.—The city of Thomasville, Ga., has voted $50,000 in aid of this road, which is projected to run from Augusta to Thomasville, Ga., a distance of 230 miles. C. E. SMITH, of Augusta, Ga., is President.

Camden, Chester & Gaffney City.—J. O. SARRAT of Gaffney City, S. C., President, sends us the following information:

The road is to run from Florence, S. C., via Camden, Chester, and Columbus, to Knoxville, Tenn., a distance of about 300 miles. There will be only one bridge of any size. The principal business of the road will be in iron ore, timber, lime, and farm products. C. L. KINGSLEY, of Gaffney City, is Chief Engineer.

NORTHWEST.—Existing Roads.

Northern Pacific.—The annual report of this company for the fiscal year ending June 30, 1889, shows the following results of operations as compared with the previous year:

	1889.	1888.
Gross earnings	$19,707,467	$15,846,327
Operating expenses and taxes	12,185,944	9,266,884
Net earnings	$7,521,523	$6,579,443

During the year the Northern Pacific & Cascade Railroad has been extended 8.2 miles. The Tacoma, Orting & Southeastern Railroad has been constructed for a distance of 7.6 miles. The Northern Pacific & Montana Railroad has been extended 6.4 miles. A section of this road is now under construction from Gallatin on the Northern Pacific Railroad to Butte, Mont., which will give a line to the East 106 miles shorter than by the way of Garrison and Helena. The Central Washington Railroad is being constructed from Cheney westward into the Big Bend country. Sixty-six miles of track have already been laid. The road is under construction to Grand Coulee, about 117 miles from Cheney, and will be

extended to the Columbia River as fast as circumstances will justify.

Canadian Pacific.—About 120 miles of the grading on the Qu' Appelle, Long Lake & Saskatchewan R. R has been completed, and work is being pushed. It is stated that work will not stop at Saskatoon this season unless the weather prevents further progress. About 3,000 men and 1,300 teams are now at work on the line. A large number of men will be employed the entire winter in getting out ties and timber for the bridges and stations. The road will be pushed, and it is now expected that it will be completed by Jan. 1, 1891.

Chicago & Northwestern.—Campbell & Sons, of Dodge Center, Minn., have the contract for building the 3-mile branch from Kasson to Mantorville, Minn.

Sault Ste. Marie & Southwestern.—Tracklaying has begun on the extension from Osseo to Mondovi, Wis., and it is expected to have it completed this year. It is announced that the money necessary to build the line from Fairchild, Wis., east has been secured.

Chicago, St. Paul & Kansas City.—It is announced that this company has purchased the charter granted a syndicate of St. Joseph, Mo., capitalists for a railway from St. Joseph to Kansas City, Mo., in 1884, and will build an extension from St. Joseph to Kansas City. The length of the line will be 49 miles.

Louisville, Evansville & St. Louis Consolidated.—At a meeting of the stockholders of this company recently held the following officers were elected: D. J. MACKEY New York, President; W. HEILMAN, Evansville, Ind., Vice-President; W. J. LEWIS, Evansville, Ind., Secretary and Treasurer. Directors, C. C. BALDWIN and JAMES HEILMAN, New York; GUSTAVUS A. KOERNER and EDWARD H. WANGELIN, Belleville; THOMAS SCOTT, Fairfield, Ill.; WM. HOPKINS, Peoria, Ill., and B. WILSON, Springfield, Ill.

Grand Tower & East Cape Girardeau.—Tracklaying on this road has been completed from Grand Tower to East Cape Girardeau, Ill., a distance of 28 miles. As soon as the ballasting has been completed the road will be opened for traffic.

Projects and Surveys.

Ava, Grand Tower & Cairo.—Incorporated in Illinois to build a line of railway from Ava, Jackson County, via Grand Tower, to Cairo, a distance of about 65 miles Among the incorporators are: WM. E. TALBOTT; WHITNEY GILBRETH, JOHN CONNOR and SAMUEL H. DOUGLAS. The principal offices will be at Ava, Ill.

Iowa & Nebraska.—Articles of incorporation have been filed in Iowa for a line of railway to run from Dubuque, via Des Moines, Red Oak, and Nebraska City, to Lincoln, Neb, The officers are; WILLARD T. BLOCK President; BUREN R. SHERMAN, Vice-President; D. S GRANT, Secretary, and WM. P. WATSON, Treasurer.

St. Paul Transfer.—A project is being agitated to build a railway from Mendota, Minn., to the Union stock yards, at South St. Paul, thence across the Mississippi River by a bridge.

Chicago Central.—This company has been incorporated in Illinois to build lines of railway from Chicago to the western boundary of the State, near the southern boundary of Adams County; and from Chicago to the eastern boundary of the State, at a point near the southern boundary of Iroquois County. The capital stock is $1,000,000. The principal office is to be at Chicago, and the first Board of Directors is to be as follows: MILTON R. WOOD, CHARLES W. NEEDHAM, ERWIN E. WOOD, WM. L. Moss and EDWARD L. WAUGH, all of Chicago.

Huron, Chamberlain & Black Hills.—The officers of this company, which proposes to build a railway from Huron to Chamberlain, Dak., 80 miles, are: D. H. HENRY Chamberlain, Dak., President; F. E. STEVENS, of Huron, Vice-Pres.; L. W. LOOMIS, of Alpena, Dak., Secretary; J. H. STEARNS, of Chamberlain, Treasurer, and E. T. HANNISTON, of Alpena, Chief Engineer.

Woodville & Southern.—Incorporated in Wisconsin to build a railway from Woodville, St. Croix County, to Wildwood in the same county, a distance of 10 miles. Among the incorporators are: E. S. AUSTIN, ROBERT CLOUSTON, A. J. MUMFORD, CHAS. H. ADAMS, and WM. H. TURNER.

SOUTHWEST.—Existing Roads.

San Antonio & Aransas Pass.—The work of construction on the various branches of this road is being rapidly pushed forward. The grading on the line from Luling to Lockhart, 16 miles, is nearly completed and it is expected that trains will be running by Nov. 1. Tracklaying is in progress on the branch from West Point to Waco, 120 miles, and it is announced that the line will be completed by Dec. 1. The company is considering a further extension from Lockhart to Georgetown, Tex. The preliminary surveys for the proposed extension from Houston, Tex., to Alexandria, La., has been completed for a distance of 44 miles from Houston east. Locating surveys are now in progress and as soon as these are completed it is expected that construction will be begun.

Kansas City, Wyandotte & Northwestern.—A large force of men is now at work laying track on the Kansas City & Beatrice R. R., and it is announced that the line will be opened for traffic Nov. 1. Surveys are now in progress on the line from Carbondale to Wichita, Kan. It is expected that this line will be put under contract early next spring and the work pushed rapidly to completion.

Kansas City, Rich Hill & Eldorado.—A press dispatch from Nevada, Mo., states that Col. ED. BROWN, the proprietor of this road, has completed arrangements for the capital necessary to build the road. The line is reported graded from a point 9 miles from Eldorado to Nevada. The line will be completed from Walker, Mo, to Eldorado by Jan. 1.

Chicago, Rock Island & Pacific.—The line from Pond Creek to Kingfisher, I. T., 65 miles, has been completed and will be opened for traffic immediately.

Missouri Pacific.—The companies noted last week as incorporated in the interest of this company will build lines as follows: The Fort Scott & Southern R. R. Co, will build a line from Fort Scott, Kan., to Minden, Mo.; the Fort Scott & Eastern R. R. Co, will build from Fort Scott to Tipton, Mo., a distance of 130 miles; the Fort Scott Terminal R. R. Co. will build stations and terminals for the various railways of the Gould system entering Fort Scott.

Projects and Surveys.

St. Louis & California.—It is stated that a bill will be introduced into the coming session of Congress incorporating a company by this name. The object of the company is to build lines of railway as follows: a line from Rogers, Benton County, Ark., in a general westerly direction through Oklahoma, Texas, and New Mexico to a point on the Atlantic & Pacific R. R. near Albuquerque, a distance of about 800 miles; a line from Tahlequah, I. T., south to a point on the Red River; a line from Fort Smith, Ark., northwest, a distance of about 375 miles; a line from Kosomo, I. T., southwest to a point on the Red River, about 75 miles, and a line from a point on the Arkansas River, near Webber's Falls, I. T., northwest to the northern boundary of Indian Territory, near Caldwell, Kan., a distance of about 195 miles.

Fort Worth & Albuquerque.—A press dispatch from Fort Worth, Tex., states that the $40,000 subsidy asked of the city of Fort Worth has been raised and that the work of construction will soon commence.

ROCKY MT. AND PACIFIC.—Existing Roads.

Alameda County Terminal.—A. C. RUMBLE, of Oakland, Cal., Chief Engineer, writes us that this road, which is projected to run from San Leandro, Cal., along the Castro valley, a distance of 15 miles, has been completed for a distance of 4 miles. The company is now waiting for a supply of rails. Tracklaying will begin as soon as these arrive, and the road will be completed building by Dec. 31, 1889. The road will do a large business in stone and farm produce.

Ilwaco & Shoalwater Bay.—F. B. HABERSHAM, Chief Engineer, writes us that this road is completed from Ilwaco to Narcotta. The business of the road is mainly in local passenger and freight traffic. The work was all done by the company.

San Francisco & North Pacific.—The branch from Santa Rosa to Sebastapol, Cal., is nearly completed. Tracklaying is completed to within 3 miles of Sebastopol.

Oregon Pacific.—It is stated that a contract for grading 15 miles of this road east, from the contract of Antonelle & Doe, has been let to Orman & Crook, of Pueblo, Col. The contractors have shipped their plant to Albany, Ore., and will commence work at once.

Santa Fé Southern.—Plans and profiles for the proposed extension from Santa Fé to the San Pedro mining camps are being made preparatory to the early commencement of work.

Olympia & Chehalis Valley.—It is stated that this road has been sold to eastern parties, who will make important improvements on the line. The roads will be changed to broad gauge and considerable other work will be done in improving the road bed.

San Diego & Eastern Terminal.—Contracts have been let for the building of the trestle bridges on the San Diego and Eastern terminal line, and the first will be completed in thirty days.

Los Angeles & Pacific.—It is reported that this road has been sold to a syndicate of capitalists, who will extend the road, via Hueneme, Ventura, and Santa Barbara to San Francisco.

Oregon & Washington Territory.—The line from Walla Walla to Dayton, W. T., 34 miles, has been graded to within 4 miles of Dayton. About 11 miles of track have been laid.

Projects and Surveys.

Siuslaw & Eastern.—We have received the following information from A. C. HOVEY, of Eugene, Ore., President:

The preliminary survey has been completed for this road from Eugene to Florence, Ore., a distance of 50 miles, and the plans and profiles are now being made. The route is through a fine timber region affording easy grades and curves. There will be only a few small bridges on the line. The right of way has all been secured. Contracts for construction will be let some time next summer. ALFRED KIRKLAND, is Chief Engineer.

San Francisco & Santa Cruz.—The survey has been completed for the line from Calma, Cal., along Crystal Lake to the Santa Cruz mountains. There will be a tunnel 1,500 ft. long.

Pueblo & Western.—N. F. ANDERSON, of 311 South Union Ave., Pueblo, Col. has sent us the following information.

The road will run from Pueblo, via Beulah and Rosita to Wet Mountain valley a distance of 55 miles. A portion of the line has already been surveyed and work will commence on the remainder at once. About 25 miles of the line will be light prairie work and the remainder cañon work. The principal business of the road will be in minerals, building stone, lime and fire clay. The route is through a section of the State rich in minerals, building stone and timber and welladapted to stock raising. The first 25 miles can be built at nominal cost. There will be few tunnels or bridges. J. C. TELLER, of Denver, Col., is President.

Grant's Pass & Coast.—It is stated that the early completion of this road is assured. The road will run from Grant's Pass, Ore., to Boise City, Idaho, 450 miles. J. T. FLYNN, of Grant's Pass, is interested.

RAPID TRANSIT.

Cable Railways.—***New York, N. Y.***—The Broadway & 7th Ave. Ry. Co. proposes to adopt a cable system for the Broadway line, and has applied to the city for permission.

Spokane Falls, Wash.—The local syndicate owning the cable railways has purchased the horse-car lines, and will extend the cable system at a cost of $300,000.

Seattle, Wash.—The contract for the power house of the Madison St. line has been awarded by the Pacific Cable Construction Co. to Charles Esplain. The rails, slot irons, and yokes are being made by the Pacific Rolling Mill Co., of San Francisco.——Mr. J. M. THOMPSON is interested in a project for a cable line at West Seattle.

Los Angeles, Cal.—The Pacific Ry. Co., of Chicago, Ill., has acquired all the franchises and property of the Los Angeles Cable Ry. Co. for $2,500,000.

Denver, Col.—The Larimer St. cable road was opened Oct. 15. The cable is 33,000 ft. long, and the driving plant was built by the Robert Poole & Son Co., of Baltimore.

Electric Railways.—***Beverly, Mass.***—The Beverly & Danvers electric road was opened Oct. 18. It is operated by storage battery cars built by the Union Electric Car Co., of Boston.

Salem, Mass.—The Naumkeag St. Ry. Co. has been authorized to increase its capital stock $200,000 for the purpose of putting in an electric system.

Syracuse, N. Y.—An electric road is projected to Fayetteville and Manlius.

Pittsburg, Pa.—A new electric system, invented by Mr. MCELROY, of the Hammond Electrical Co., is being tried on Carson St. Electrical machines under the track, at intervals of 18 ft., are connected by wire with a dynamo in a central station. A Sprague motor is fitted to the car, and an arm running on the surface of the street bears on metal discs over the machines and conveys the current to the motor.

Memphis, Tenn.—The Memphis Electric Ry. Co. has been granted a franchise for 30 years.——The Citizens' St. Ry. Co. has awarded a contract for the electric equipment of its line to the Thomson-Houston Co.

Knoxville, Tenn.—The Knoxville St. Ry. Co. has adopted the Thomson-Houston system for its electric line, and has ordered cars from the Pullman Car Co.

Hamilton, O.—The Hamilton Electric St. Ry. Co. has bought out the old street railway company, and will put in an electric system as soon as the city grants permission.

Rockford, Ill.—The street railway company has sold out to a Chicago syndicate for $35,000; the new company will put in an electric system and build extensions.

Racine, Wis.—The street railway has been sold to Chicago capitalists who will put in an overhead wire electric system.

Seattle, Wash.—The Green Lake Electric Ry. Co. has been incorporated by V. H. SMITH, L. H. GRIFFITH JAMES LEDDY, and others. Capital stock, $150,000.

Street Railways.—***Rochester, N. Y.***—The Crosstown St. Ry. Co. has purchased the franchises of the Rochester City & Brighton St. Ry., the Rochester Electric Ry., the Rochester & Lake Ontario Ry. and the Rochester & Glenham Ry.

Pittsburg, Pa.—The Hazlewood Ave. St. Ry. Co. has been incorporated by CHAS. L. KING, W. H. HOFFMAN and F. C. KOHNE. Capital stock, $7,500.

Chester, Pa.—The Chester St. Ry. Co. proposes to build a line to Media. E. M. CORNELL is President.

Baltimore, Md.—The North Ave. Passenger Ry. Co. and the Central Passenger Ry. Co. have applied for power to adopt electric or cable traction on their lines.

Washington, D. C.—The Washington & Georgetown Ry. Co. is said to have contracted for the Judson pneumatic system. This system was described in ENGINEERING NEWS, July 13, 1889.

Roanoke, Va.—The Roanoke St. Ry. Co. has 10 miles of line in operation and 8 miles more under contract. The longest extension is to Salem and Vinton. Dummy engines are used on 5 miles of the road.

Charleston, W. Va.—The Charleston St. Ry. Co. has been incorporated. Capital stock, $25,000. President, J. L. BEWBY; Treasurer, J. D. CAMPBELL; Secretary, E. W. BRIDGE.

Flint, Mich.—An exclusive franchise for a street railway has been granted to C. D. HAINES, of Kinderhook, N. Y.

Grand Haven, Mich.—A franchise has been granted to C. D. HAINES, of Kinderhook, N. Y., for a street railway in the city, with an extension to Spring Lake.

Carlinville, Ill.—The Carlinville St. Ry. Co. has been incorporated by A. L. GIVEN, F. L. BATES and B. M. BATES. Capital stock, $25,000.

Tower, Minn.—A company has been organized to build a street railway to Soudan. Capital stock, $50,000. For further particulars address Mr. SHEPARD, Register.

Fort Scott, Kan.—The Fort Scott St. Ry. Co. has been incorporated by WARREN REED, JACOB CONINE, JAMES POWELSON, and others. Capital stock, $25,000.

Kansas City, Kan.—An amended franchise has been granted to D. M. EDGERTON for a line from the Riverview station to Armstrong and Amourdale.

Omaha, Neb.—The Consolidated St. Ry. Co. has purchased the Mercer electric road and now owns all the horse, cable and electric lines in the city, aggregating 72 miles.

HIGHWAYS.

Good Roads.—The need of good roads is at this time of year most strongly felt. Hauling farm produce to market has already begun, and farmers who are compelled to haul the products of their farms ten or fifteen miles over rough, uneven road, are put to a great disadvantage. The loss caused by bad roads often more than balances the profits of the season's work on the farm. The advantages of good roads are many. Larger loads can be hauled over them without danger of breaking down. Horses are spared the constant strain and jerking of the wagon tongue which are caused by a stony, uneven roadbed. The time saved in a year is considerable, and farms are worth more where good roads predominate.—*The Husbandman*, (September).

Macadamized Roads.—Madison County, Alabama, is making good progress in the effort to get fine roads. They will be of inestimable value when once obtained, and although the cost will be great, it will be money well spent. The Huntsville *Mercury* says:

"This pike from Meridianville north towards the State line is equal to any road we ever saw, and we have traveled on the shell road at Mobile, the macadamized roads of Tennessee, and the gravel pikes of Kentucky. The grading is perfect and the gravel used is of superior quality, just fine enough to pack or cement together and just coarse enough to wear well. This pike is being built by Messrs. Jones & Powell, who are novices at pike building, but their work shows that they understand the business. They are pushing the work to completion, and if wind and weather permit they will have finished long before another full moon.

It would pay any county whose roads become impassable in the winter to get them macadamized. The good result would be soon seen and appreciated.

Kansas.—The people of Argentine are interested in a scheme for securing a new county boulevard leading from Kansas City to the western limits of the county. Although the road may not touch a large portion of the city, yet the people feel that they will be greatly benefitted by such a thoroughfare, and will lend every effort to secure its construction. Several land investment companies have promised to help the matter along, and it is probable that the county board will also take some action. Argentine needs a good macadamized road leading to Kansas City.

West Virginia.—The contract for constructing about 6 miles of the turnpike to Hamlin has been let to B. BIAS, M. SWAN, HENRY MORRISON and J. BOHN at $5,499.

Tolls on Bad Roads.—Whether a turnpike company can collect tolls on roads that are unfit for travel is about to be tested in the Burlington County (N. J.) courts. Suit has been begun by ROBERT BROCK, Tax Collector for Delran township, Burlington County, against the Camden & Burlington Turnpike Co., on a charge of collecting tolls when their turnpike was not in a proper condition to travel over it.

Colorado Roads.—The following proposals have been received by J. P. MAXWELL, State Engineer, Denver, Col., for the Bear River wagon road. The road will be 5 miles long, built for the State: the appropriation was $5,000. S. L. Smith, Leadville, Col., $4,060: Gaddis & Packer, Steamboat Springs, Col., $4,075. The contract was awarded to S. L. Smith.

Road Mending.—A correspondent signing himself C. R. C. asks if any of our readers can refer him to a treatise on road-mending in poor municipalities, especially the mending of clay roads where stone is scarce. The proceedings of the various engineering societies of Illinois, Indiana, and Michigan give some data on this subject, but we would be pleased to publish any fresh matter.

CONTRACTING.

Court House and Jail.—The following proposals for the construction of a new court house and jail at Columbus, Tex., have been received by A. T. HEINER, Architect, Houston, Tex.: J. O. & J. A. Wilson, Greenville, Tex.; all brick, without iron of jail, $59,707. A. Baumbach, Houston, Tex., without iron of jail, all brick, $55,594; with stone trimmings, $64,194. J. M. Mather, Houston, Tex.; without iron of jail, $56,120 all brick, or $65,150 with stone trimmings. Martin, Byrne & Johnson, Colorado City, Tex., inclusive of iron of jail, $58,296 all brick, $59,296, with Belton stone trimming, $54,599 with same trimmings, but without iron work. For iron work: Lane Bros., Newark, O., $4,761.28, $4,861.28, $5,275, $5,475. Pauly Jail & Mfg. Co., St. Louis, Mo.; 8 bids ranging from $4,643.90 to $6,333.79. Champion Iron Works, $4,145 as per plans, or $4,300 with 5-16-in. steel. Diebold Safe & Lock Co., Canton, O. (agent, L. T. Noyes Houston), $4,615 as per plans, or $4,765 with steel rivets. The contract for building was awarded to Martin, Byrne & Johnson, of Colorado City, at $54,596, with Belton stone trimmings. The contract for iron work of jail was let to the Diebold Safe & Lock Co., at $4,615.

Contractors' Directory.—Our special Directory of Railroad Contractors to be published in "Engineering News Atlas of Railway Construction" reveals the worthless character of so-called "reliable lists" of railroad contractors. Out of 2,500 sealed letters sent to the addresses given by these "reliable lists," one month ago, one half are yet unheard from, and of the other half the largest proportion have been returned as "unknown" or "uncalled for." Some are returned as "dead." In many cases the parties had no claim whatever to be called "railroad contractors," or indeed contractors for anything except as every man is a "contractor." The labor and expense of sending circulars to and soliciting business of these "reliable lists" of men has been almost entirely thrown away. The Directories we are now preparing will not contain nearly so many names as some of the "reliable lists" heretofore published, but we can assure the parties who want to use the addresses that they will be as accurate and complete as human ingenuity and unstinted labor and expense can make them. If any bona fide reliable railroad contractor neglects to send his card, giving specialty and permanent address, he may see reason to regret it when he finds he is omitted in December and fails to make the acquaintance of hundreds of the leading railroad managers, superintendents, and engineers in January. It costs only two cents postage to get into this Directory, provided a man is a railroad contractor: if he is not a railroad contractor, he will not get in at any price. And hereafter the ENGINEERING NEWS Directory of Leading Railroad Contractors of America will be the standard, to be copied and reprinted by all our "esteemed" but less enterprising contemporaries.

Jetties.—The contract for jetties and removing the bar at Georgetown, S. C., has been awarded to G. S. Howell, 93 Wall St., New York City. The work will amount to about $82,000.

Street Work.—***New York, N. Y.***—The contract for an asphalt pavement on Park Ave., from 34th to 40th St., to be laid over the present stone block pavement, has been awarded by the Commissioner of Public Works to the Barber Asphalt Co. at $44,000. The guarantee is for 15 years.

Brooklyn, N. Y.—The following proposals have been received by the Commissioner of City Works: Belgian block pavement and bluestone curb on Fulton St., Luck & Fitzgerald, $14.83 per lin. ft.; Belgian block pavement and bluestone curb on Rockaway Ave., Charles Hart, $9.69 per lin. ft.; granite block paving on Bushwick Ave., Charles Hart, $14.85 per lin. ft.

Albany, N. Y.—The contract for asphalt paving on Allen St. has been awarded to the Barber Asphalt Paving Co., of New York; $3 per sq. yd. for asphalt, 5 cts. per lin. ft. for 18 ft. sidewalk, flagged and sodded, 5 cts. per lin. ft. for 4-in. straight and circular curb. The National Vulcanite Co., of Jersey City, N. J., bid $2.40, $1.70 and 80 cts.—The contract for granite paving on Lark St. has been awarded to Jacob Holler: $2.83 per sq. yd. for granite, $1 per lin. ft. for curb, $1.05 for circular curb, 25 cts. for resetting old curb, 30 cts. per sq. ft. for crosswalks, 65 cts. per sq. yd. for relaying granite, 15 cts. per lin. ft. credit on old curb, 3 cts. per sq. yd. credit for cobble.

Omaha, Neb.—The Board of Public Works has awarded contracts for paving 30th St. J. E. Riley & Co., Woodruff sandstone on sand, $2.15; Galesburg brick, $2.03. Hugh Murphy, Sioux Falls or other granite, $3.36; Colorado sandstone, $2.31; Woodruff sandstone, $2.15; cedar blocks on concrete, $1.65; cypress blocks, on concrete, $1.95. James Fox, sheet asphaltum, forms A, B and C, $2.74, $2.54 and $2.34 respectively. J. C. Regan & Co., cedar blocks on sand and plank, $1.44; cypress blocks on sand and plank, $1.33 and $1.35; concrete, $1.63.

Sewers.—***Newark, N. J.***—The following contracts were awarded Oct. 15 by ERNEST ADAM, City Surveyor, Madison St.: Ralph Satchwell, 70 cts. for 12-in. pipe, $25 for manholes, $422. Ferry St.: Ralph Satchwell, $1.30, $1.10 and 84 cts. for 18, 15 and 12-in. pipe, $30 for manholes, $95 for basins, $3,753. Mt. Prospect Ave.: P. Harrison, $1.60 and 95 cts. for 18 and 10-in. pipe, $30 for manholes, $100 for basins, $3,017.

Harrisburg, Pa.—John A. Kramer has the contract for 12-in. pipe sewers as follows: Balm St., 295 ft. of sewer and 21 Ys, $229.50; Linden St., 295 ft. and 27 Ys, $243.50; Basin Ave., 175 ft. and 8 Ys, $139.

Fort Monroe, Va.—The following proposals for a sewerage system were opened Oct. 19 by COL. PETER C. HAINES, U.S. Engineer Office, Washington, D. C.: Crook, Horner & Co., Baltimore, Md., $35,749.48; B. J. Coyle & Co., Washington, D. C., $38,627: McCarthy & Baldwin, Washington, D. C., $41,910.78; James J. Powers, Brooklyn, N. Y., $97,000.

Louisville, Ky.—The contract for a large brick sewer, 11 ft. diameter, has been awarded to George Krupp at $35,135.

Cincinnati, O.—The contract for the Lick Run sewer has been awarded to Daniel Minahan for $19,192.85.

Sewers.—***Boston, Mass.***—The following proposals were opened and contracts awarded on Oct. 15 by Mr. WM. JACKSON, City Engineer. The contracts were awarded as follows: Section 1, H. Nawn; Section 8, Metropolitan Construction Co.; Section 9, Collins & Ham.

Section 1—Brighton Intercepting Sewer.

Bidders	Earth excavation and refill in sewer trench	Brick masonry American	Brick masonry Portland	Concrete masonry	Rubble masonry	Dimension stone masonry	Spruce timber	10-in. drain pipe	Pipe for regulator	Earth excavation outside of sewer trench	Pipe connections	Total
	1,822 lin. ft.	1080 cu. yds.	20 cu. yds.	180 cu. yds.	650 cu. yds.	2 cu. yds.	41 B. M. ft.	1,850 lin. ft.	68 lin. ft.	570 cu. yds.		
	$	$	$	$	$	$	$	$	$	$		$
H. Nawn, Boston	6.57	12.89	15.00	5.00	4.50	20.00	26.00	0.45	0.40	0.80	....	34,170.24
C. Linehan, Cambridge	9.50	13.00	15.00	4.50	5.50	15.00	28.00	1.25	5.00	0.60	....	43,006.50
National Construction Co., Boston	9.89	13.75	15.68	4.85	5.65	38.00	26.50	0.60	1.00	1.00	....	42,573.19
Metropolitan Construction Co., Boston	11.90	12.15	14.00	6.45	6.15	45.00	28.00	0.50	0.75	1.50	....	45,891.30

Section 8—South Boston Intercepting Sewers.

	2,363 lin. ft.	630 cu. yds.	20 cu. yds.	140 cu. yds.	200 cu. yds.		20 ft. B. M.	2,363 lin. ft.			178 in all	
	$	$	$	$	$		$	$				$
Metropolitan Construction Co., Boston	3.85	12.43	14.25	6.45	6.15	.....	35.00	0.50	.....	.....	0.60	21,332.95
Collins & Ham, Boston	3.75	13.00	15.00	5.25	5.50	.....	26.00	0.75	.....	.....	3.50	22 091.00
National Construction Co., Boston	4.50	13.65	15.75	5.65	6.15	.....	27.00	0.60	.....	.....	0.75	23,658.05

Section 9—South Boston Intercepting Sewer.

Bidders	Earth excavation and refill in sewer trench 36 x 48 ins.	Earth excavation and refill in sewer trench for 24 x 36 ins.	Brick masonry American	Brick masonry Portland	Concrete masonry	Rubble masonry	Spruce lumber	Pipe connections	10-in. pipe drain pipe	Total
	693 lin. ft.	1,184 lin. ft.	400 cu. yds.	25 cu. yds.	100 cu. yds.	160 cu. yds.	16 ft. B. M.	140 in. all	1,877 lin. ft.	
	$	$	$	$	$	$	$	$	$	$
Collins & Ham, Boston	2.75	2.75	13.00	15.00	4.50	5.25	25.00	2.00	0.60	13,852.95
National Construction Co., Boston	3.84	3.12	14.00	16.00	5.45	6.05	25.00	0 60	0.65	15.572.25

Denison, Tex.—The contract for constructing the new sewerage system was awarded Oct. 15 to John McDonald of Fort Scott, Kan., at $47,487 90. The other bids were as follows: James Pryor, Kansas City, Mo., $48,746.95; W. J. Irwin, Greenville, O., $52,326 50; Doyle & Farrell, Kalamazoo, Mich., $52 834.75; W. B. Brush, Austin, Tex., $54,766.20; Rockford Construction Co., Rockford, Ill., $57,9 7.80; A. F. Foster, Aiton Junction, Ill., $58,232 25; Robert C. Storrie, Dallas, Tex., $66,166.50; Perry & Cullinane, Denison, Tex., $66,614.75; G. P. C. Rumbaugh, Little Rock, Ark., $68,555.20; J. F. O'Connor, Dallas, Tex., $75,756.70; Geo. L. Gillespie, Chattanooga, Tenn., $71,393.20; Clements Bros., Cleveland, O., $79,042.55.

PROPOSALS OPEN.

Railway.—About 35,000 cu. yds. of rock cut and fill, on the railway extension between Tekanto and Izamal, Yucatan. JOHN W. GLENN, Contractor, 48 Carondelet and 339 Josephine St., New Orleans, La.

Sewers and Street Work.—Barber asphalt and Medina sandstone paving; 30-in. 24-in. and 20-in. brick sewers; 18, 15 and 12-in. tile sewers. The CITY CLERK, Buffalo, N. Y. Oct. 28.

Building.—Machine shop on Albany St. THE WATER BOARD, Boston, Mass. Oct. 29.

Sewer.—In Pennsylvania Ave.: 500 ft. of 24-in. pipe; 260 ft. of 18-in., 500 ft. of 15-in., 260 ft. of 12-in., 950 ft. of 10-in., 5 basins, 15 manholes. ERNEST ADAM, City Surveyor, Newark, N. J. Oct. 29.

Pier Work.—New wooden pier and appurtenances at W. 50th St., North River; yellow pine, spruce and oak timber, piles; iron spikes, nails, bolts, washers and straps; 2,000 cu. yds. of rip-rap. THE DOCKS COMMISSIONERS, Pier A, North River, New York City. Nov. 1.

Street Work.—Granite block paving. THE COMMISSIONER of PUBLIC WORKS, 31 Chambers St., New York City. Nov. 1.

Macadamizing.—On Troost Ave. FRANK J. O'FLAHERTY, County Surveyor, Water-Works Building, Kansas City, Mo. Nov. 2

Hoisting Engines.—Combined stationary hoisting engines and appurtenances required at Shaft No. 25, Section 12, New Croton Aqueduct. JAMES C. DUANE, President, Aqueduct Commissioners, 280 Broadway, New York City. Nov. 6.

Cement.—About 1,700 bbls. of cement, 100 bbls. of lime and 3,000 bbls. of sand. JAMES FULTON, Paymaster General, U. S. N., Navy Department, Washington, D. C. Nov. 8.

Court House.—For King Co., at Seattle. Architect W. A. RITCHIE. W. R. FORREST, Clerk of County Commissioners, Seattle, Wash. Nov. 11

Lighthouse.—At Newport News, Va. Capt. J. C. MALLERY, U. S. Lighthouse Engineer, Baltimore, Md. Nov. 15.

Dredging.—Dredging and removing bars and other obstructions from the Cuyahoga River, the old river bed and Sycamore St. slip. WALTER P. RICE, City Engineer, Cleveland, O. Nov. 16.

MANUFACTURING AND TECHNICAL.

Market Prices.—*Rails.*—New York and the East: $31.50 to $32 at Eastern mills. Old rails, $24.50 to $25. Pittsburg: $33.50. Old rails, $26.50 to $27. Chicago: $34 to $35 for standard sections. Old rails, $25.50 for iron, $19 to $20 for steel.

Track Material.—New York; steel angle bars, 1.95 to 2 cts., delivered. (cheaper than iron); spikes, $2.20 to $2.25 delivered. Pittsburg; spikes, 2.10 cts., 30 days; splice bars, 2 cts.; track bolts, 3 cts. with square and 3.10 cts. with hexagon nuts.

Scrap.—Chicago; dealers quotations for net ton: No. 1 forge or railway shop, $21; No. 1 mill, $16; No. 2 mill, $11; car-axles, $25; fish-plates, $21.75; horseshoes, $16.50; wrought pipe, $14.50; cast machinery, $13; cast borings, $8.75; wrought turnings, $12.50; axle turnings, $14.50; locomotive tires, $17; leaf steel, $17.50; coil steel, $16; mixed steel, $13; mixed country scrap, $17.

Locomotives.—The Baldwin Locomotive Works, of Philadelphia, Pa., have delivered 25 engines to the Texas & Pacific.

The Rhode Island Locomotive Works, of Providence, R. I., have built 4 engines for the Fitchburg, 1 mogul fast passenger engine for the New York & New England, and 3 engines for the New York, Providence & Boston. The works are now building ten-wheel engines for the Georgia Southern & Florida, the Kansas City, Fort Scott & Memphis, and the Columbus Southern; eight-wheel, ten-wheel, and switch engines for the East & West Alabama, and six-wheel switch engines for the Bessemer Iron & Coal Co., of Bessemer, Ala.

The Savannah, Americus & Montgomery Ry. Co. has recently added to its equipment two Baldwin 30-ton mogul locomotives; one Baldwin 45-ton eight-wheel passenger engine; two 45-ton Rhode Island ten-wheel freight engines; one 45 ton eight-wheel passenger and one 53-ton ten-wheel freight engine from the Rhode Island Locomotive Works.

Iron Cars.—The Minnesota Iron Car Co., of Duluth, Minn., has been reorganized. President, John F. T. ANDERSON; Vice-President, Col. TANNER; Treasurer, GEO. W. ETTENGER; General Manager, R. L. ETTENGER. Capital stock, $2,000,000.

The Essex Construction Co. has been incorporated at Newark, N. J., by J. THOMAS BUBB, of Newark, and JOHN C. KILBRETH and H. POWERS FARR, of New York. Capital stock, $100,000. The company proposes to contract for the construction of railways, roads, canals, bridges, etc.

An Engine's Record.—At the Oliver Oil Co.'s mill at Charlotte, N. C., is a 65 H. P. Westinghouse engine, which has been operated night and day (starting at 12 o'clock Sunday night, and stopping 12 o'clock Saturday night) for 5 years, and during that time it has not, so it is stated, cost $5 for repairs, and the mill has never istopped a minute on account of the engine.

The American Development Co., of 45 Broadway, New York City, has been organized for the purpose of securing control, either by purchase or on long term options, of large bodies of timber, grazing and mineral lands, ranches, mines and mining properties of all kinds, manufacturing and other industrial enterprises, and the securities of railway and other corporations, and effecting their sale to American and European capitalists, and also the readjustment of defaulted national, State, municipal and railway indebtedness. President, J. P. COOKE; Secretary, F. M. STEVENS. Paid up capital, $300,000, with power to increase to $1,000,000.

Street Car Brakes.—The Eames vacuum brake has been applied to the electric cars at Newport, R. I., and the driver of the motor can therefore apply brakes throughout the train, when cars are coupled together, instead of relying on the motor car brakes alone. They are worked in the same way as the Brooklyn Bridge cable cars.

Car Trucks.—The Chicago Railroad Car Truck Co. has been incorporated by HARTSWELL KENDALL, G. F. WILLIAMS, and ARNOLD W. ZIMMERMAN. Capital stock, $500,000.

Steel Plates.—Secretary TRACY has rejected the bids for steel plates received for the armored battle-ship *Texas*, as excessive and not to the interest of the Government to accept.

Cars.—The Litchfield Car & Machine Co. has an order for 200 box cars of 50,000 lbs. capacity for the Kanawha Dispatch Co.; they will be equipped with air brakes.

The St. Charles Car Co., of St. Charles, Mo., has an order for 500 box cars for the Colorado Midland; they will be equipped with Westinghouse brakes, steel brake beams and Dunham car doors.

The Haskell & Barker Car Co., of Michigan City, Ind., is building 100 refrigerator cars for the Chicago, Milwaukee & St. Paul.

Locomotive Works.—The Richmond Locomotive & Machine Co., of Richmond, Va., has increased its capital stock to $2,500,000.

Street Railway Cars.—The St. Louis Street Car Mfg. Co., of St. Louis, Mo., has been organized, and J. H. KOBUSH, P. M. KLING, HENRY KRAFT, H. ROTHERMEN, J. RODDEGER, ERNST SCHILLING and G. J. KOBUSH have been elected directors. Secretary, GEO. J. KOBUSH.

Woeber Bros., of Denver, Col., will build new and extensive works for the manufacture of street and cable cars.

The Laclede Car Co., of St. Louis, Mo., has orders for 40 grip cars and 40 passenger cars for the Denver City Cable Railroad, 20 grip cars and 10 open cars for the Kansas City Railroad Co., 20 closed and 10 open cars for the St. Paul Cable Railroad, and 12 motor cars for the Redondo Railway Company, Los Angeles, Cal.

Brakes.—The Beals Railway Brake Co. has an order for six sets of brakes for mogul engines now being built by the New York Locomotive Works, Rome, N. Y.

Steel Works.—The Anglo-Pacific Steel Co. will establish works at Vallejo, Cal. The works and plant will cost $1,000,000.

Railway Gate.—The Western Maryland Ry. has been experimenting with the Toulmin gate for highway grade crossings. The gates are opened by the train passing over a plate or lever in the track and are closed in the same way. Col. DOUGLAS and Major RANDOLPH, of the Baltimore & Ohio, were present at the test made at Woodbrook station. The gate is manufactured by the Toulmin Electric Co.; President, E. L. TUNIS; Treasurer, Dr. D. S. FITZGERALD.

The Hall Steam Pump Co., 91 Liberty St., New York, will move at the end of the month from its old works at Wilmington, Del., to new works at Pittsburg, Pa. The new works include machine shops and foundries and are nearly completed. The company has been unable for some months to accept all orders, and will have a number of orders in hand at the start for its new works, where the Hall duplex steam pump and power pumping machinery will be manufactured on an extended scale.

Railway Material.—E. B. Brailey, Monticello, Fla., wants lowest prices on all machinery used in railway building.

Joel A. Daniels, Welsh, La., wants the address of manufacturers of steel rails and cars.

J. H. Field, Florence, Ala., wants bids on 35-lb. rails, cars, switches, engine, etc., for a dummy railway.

The Davidson Steam Pump Co., 77 Liberty St., New York, reports the shipment of 26 direct-action steam pumps, to the Risdon Iron & Locomotive Works, San Francisco, Cal. This makes a total of 63 machines that have been sent to the Pacific Coast during the past three months.

BRIDGES AND CANALS.

Bridge Notes.—*Cornwall, Vt.*—The selectmen have let the contract to the Vermont Construction Co., of St. Albans, to build an iron bridge across Lemon Pair, on the stage road from Middlebury to Bridgeport, in place of the wooden structure erected 32 years ago.

Somers Point, N. J.—It is proposed to build a bridge to connect the turnpike roads of Atlanta and Cape May counties. It will cost about $40,000.

Dandridge, Tenn.—The Knoxville & Northeastern Ry. Co. will build a railway and highway bridge over the French Broad River.

Covington, Ky.—The Newport News & Mississippi Valley Ry. Co. will build an iron bridge 175 ft. long and 37 ft. wide, over the tracks at 15th St.

Green Bay, Wis.—Two new bridges are to be built, at a cost of about $35,000.

Yankton, Dak.—A truss bridge is to be built over the Jim River at a cost of $12,000.

St. Louis, Mo.—The plans of the Merchants' Bridge have been approved by the Secretary of War.

Topeka, Kan.—Mr. A. W. WATERS, C. E., is in favor of a six-span bridge, with three trusses to each span, across the Kaw River. The roadway would be 54 ft. wide.

Little Rock, Ark.—The Little Rock & Argenta Bridge Co. proposes to build a bridge across the Arkansas River.

Piers.—*New York, N. Y.*—Mr. GEO. S. GREEN, Jr., M. Am. Soc. C. E., engineer to the Docks Department, has presented plans for a new pier on the North River at 132d St. and a bulkhead to 133d St. The work will cost $150,000. The pier head will be in 60 ft. of water, with a bottom of soft mud.

Seattle, Wash.—The San Francisco Bridge Co. has the contract for a pile and timber wharf for the Bader Milling Co.

Canals.—The Fernandina, Jacksonville & St. Augustine Ship Canal & Transportation Co. has been organized by M. BARTHOLOMEW, J. E. T. BOWDEN and Z. HARRISON, of Jacksonville, Fla., to build a canal from Fernandina to Jacksonville and a railway from Jacksonville to St. Augustine.

The El Paso Irrigation Co., of El Paso, Tex., has let the contract for the construction of its canal to the Rosenfield Construction Co., of Denver, Col., at $70,000. It is to be 4½ ft. deep, to carry 3 ft. of water, and 30 ft. in width for 3½ miles, 20 ft. for 18 miles and 15 ft. for 9 miles. It is to be completed by February, 1890.

Zanesville, O.—The contract price for the superstructure of the Brush Creek Bridge, let to the Smith Bridge Co., of Toledo, O., was $16,000, and not $10,000 as stated on page 358. The contract for the substructure was awarded to T. B. Townsend, of Zanesville, at $5.50 per yd. The contract for the substructure of the Monroe St. Bridge was awarded to T. B. Townsend at $28,000, and the superstructure was awarded to the Columbia Bridge Co., of Dayton O. T. C. CONNAR, of Zanesville, is County Surveyor.

Oswego, N. Y.—The following proposals for building a riveted iron girder bridge, 46 ft. span, 40 ft. wide, over the hydraulic canal, were opened Oct. 16 by the Board of Public Works: King Iron Bridge & Mfg. Co., Cleveland, O., $1,840 with beech or maple floor, $2,047 with Georgia pine or oak, $2,110 with 5-in. Georgia pine (treated), $2,804 with asphalt. Dean & Westbrook, New York, $1,950 with beech or maple floor, $2,100 with pine. Penn Bridge Co., Beaver Falls, Pa., $2,750; Variety Iron Works, Cleveland, O., $2,225 with oak or Georgia pine, $2,005 with beech or maple. Wrought Iron Bridge Co., Canton, O., lumber extra, completed Jan. 1, $2,300; completed March 1, $2,200. Groton Iron Co., Groton, N. Y. $2,020 with beech or maple, $2,120 with oak or pine.

ELECTRICAL.

Electric Lighting.—*Port Richmond, N. Y.*—The Village Trustees have advertised for proposals for incandescent lights.

Oswego, N. Y.—A contract for electric lighting has been made with M. E. GRAVES for 170 arc lights at $17,000 per annum. He will purchase part of the present electric light company. He will also convert the street railway into an electric line.

Reading, Pa.—The Philadelphia & Reading R. R. Co. has awarded a contract for 55 arc lights of 2,000 c. p. at its stations, yards and grounds in the city, to the Keystone Light & Power Co., of Philadelphia.

Griffin, Ga.—An electric light company has been organized and will put in a Brush plant. President, H. E. BURR; Secretary, J. G. RHEA. Capital stock, $25,000.

Tuscaloosa, Ala.—B. F. Roden, of Birmingham, has a contract for electric lighting and will put in a Thomson-Houston plant at a cost of $25,000.

Morris, Ill.—The Morris Electric Light Co. has been incorporated by LEWIS DEGAN, CHAS. H. KERSEY, and H. L. MILLER. Capital stock, $5,000.

West Duluth, Minn.—The West Duluth Electric Light & Power Co. has been incorporated by W. H. H. STOWELL

WM. F. PHELPS and A. F. SWANSTROM. It has been granted a franchise.

Council Bluffs, Ia.—The Council Bluffs Gas & Electric Light Co. has been incorporated. President, W. S. WRIGHT; Vice-President, CHAS. P. PRATT; Secretary, CHAS. L. EASTON. Capital stock, $500,000.

Corning, Ia.—A local company has been organized and will put in a Westinghouse incandescent plant.

Mitchell, So. Dak.—The Northwestern Electric Light Co., of St. Paul, Minn., has been granted an exclusive franchise. A Thomson-Houston plant with 30 arc and 600 incandescent lights will be put in.

St. Louis, Mo.—The Laclede Gas Co. has ordered an extensive plant from the Heisler Electric Light Co.

Manhattan, Kan.—The Manhattan Electric Light Co. has been incorporated by J. B. ANDERSON, E. A. WHARTON and CHARLES G. GARETTSON. Capital stock, $25,000.

Batesville, Ark.—Address the mayor in regard to a projected electric light plant.

Rico, Col.—The Rico Electric Light & Power Co. has been organized by G. S. BARLOW, H. R. WOODALL, and C. W. CORBIN. Capital stock, $10,000.

Durango, Col.—The Durango Electric Co. has been incorporated by T. C. GRADEN, J. A. PORTER, H. SCHIFFY, and others. Capital stock, $50,000.

Buffalo, N. Y.—The contracts for electric lighting for one year from Oct. 1 were awarded Oct. 15 by J. E. BARNARD, City Comptroller, to the Brush Electric Light Co., Thomson-Houston Electric Light & Power Co., and U. S. Electric Light & Power Co. at 42½ cts. per light per night. The contracts for gas lighting for streets and public buildings were awarded to the Buffalo Gas Light Co., Buffalo Mutual Gas Light Co., and the Citizens' Gas Co., at $1,25 per 1,000 cu ft.

SEWERAGE AND MUNICIPAL.

Seattle, W. T.—The City Engineer, JOHN G. SCURRY, has presented his report for the year ending May 31. The length of streets graded was 70,112 ft., and of sidewalks laid 121,440 ft., and the average cost per front foot of abutting property was $1.76. The work included the removal of 446,208 cu. yds. of earth and the erection of 3,977,228 ft. B. M. of timber. The average cost per cu. yd. of earth was 33⅓ cts., and of lumber $17.40 per 1,000 ft. B. M. It is stated that before an intelligent arrangement of pipes or disposition of sewerage can be made, it will be necessary to adopt a detailed and specific plan showing the location, dimensions, and grades of sewers, so as to best serve the purpose for which they are designed. Pipes now being laid are not in conformity with any general plan, and to properly devise such a plan would involve surveys to show topography of the ground, elevations of the house floor and other details necessary to make up the data from which to fix the location and depth of sewers, and avoid unnecessary excavation. Such surveys as are necessary would not be expensive, and the cost would be repaid many times by the saving of needless outlay in construction. Reconnoisance surveys were made for water supply from Rock Creek, but no lines run or detail surveys made, the work consisting only of levels taken for total head available and of measurements for determining the available quantity of supply.

Washington, D. C.—Major RAYMOND has submitted to the District Commissioners the estimates for the support of the engineer department during the fiscal year to end June 30, 1891. His estimates are as follows: For salaries and contingent expenses, $50,000; for improving streets and avenues, $650,000; grading streets, alleys and roads, $25,000; repairs of concrete pavements, $100,000; material for permit work, $200,000; repairs of streets and alleys, $60,000; repair county roads, $75,000; construction of county roads and suburban streets, $204,450; condemnation of streets, alleys and roads, $5,000; surveys of the District, $15,000; care of bridges, $5,000; repair and construction of bridges, $20,000.

Cleaning and repairing sewers and basins, $42,000. Replacing obstructed sewers, $26,000. For main and pipe sewers, $125,000. Suburban sewers, $75,000; gauging sewers and rainfall, $3,000; sweeping and cleaning streets and alleys, $100,000. Parking commission, $18,000; lighting streets, $131,000; electric lighting, $45,000; harbor front, $4,000; public scales, $250; public pumps, $5,000; Washington aqueduct, $20,000; salaries, etc., board of examiners, steam engineers, $1,000; water department, all expenses, $234,374.

New London, Conn.—The Sewer Commissioners have presented their report for the year ending June 1, 1889. The engineer, W. H. RICHARDS, reports that 5,271.6 ft. of lateral sewers were laid, making the total of sewers up to date nearly 4 miles. Other work was under contract at the time. There were 69 connections made, bringing the total up to 316. In order to obtain data for preparing plans of the approximate line and grade of the sewers formerly owned by private parties, it was suggested that authority should be given to uncover them at distances of 200 or 300 ft. The total expenditure on account of sewers had been $677,380.91; the expenditures for the year were $16,607.60 for construction, and $2,762.41 for maintenance. The prices paid were 80 and 90 cts. per ft. for 8-in. pipe, $1.10 for 10-in. and $1.25 for 12-in.; rock excavation, $4 50 per yd.; manholes, $5 per vertical foot. There were in June 5.085 miles of sewers, including 1.25 miles of private sewers incorporated in the system.

Street Work.—*Manchester, Va.*—The Street Committee has recommended the expenditure of $36,997.45 for paving and curbing Decatur, Porter and 7th Sts. For particulars address the City Engineer.

Seattle, Wash.—Cedar block paving is being laid on some streets by the cable railway company.

Lincoln, Neb.—Mr. O. N. GARDNER, City Engineer, has been engaged as a special engineer for preparing plans for water-works and sewerage. The city is expending about $600,000 on brick paving and is building a $6,000 pumping station.

Sewers.—*Brooklyn, N. Y.*—The Commissioner of City Works will soon advertise for proposals for constructing the main sewers in the 26th Ward. The laterals will be built later. The appropriation for the work is $1,000,000. Plans for the disposal of the sewage have been prepared by City Engineer VAN BUREN.

Baltimore, Md.—An appropriation of $45,000 has been made for a sewer on Pulaski St.

Orange, N. J.—The Council has decided to draft a bill to be presented to the Legislature to obtain the necessary authority to issue bonds and condemn a right-of-way to tide-water for a system of sewerage. Two routes are under consideration—one by way of the Second River, through Bellevue to the Passaic River, the other through Irvington Lyons Farms and the Newark Meadows to Newark Bay.

Little Rock, Ark.—Sewer District No. 17 has been formed, and about ½ mile of sewers will be built. F. J. H. RICKON is City Engineer.

Grand Island, Neb.—The sewers in the principal streets will be completed next month. The cost has been $5 per ft., and the work has progressed about 100 ft. per day.

Los Angeles, Cal.—The Sewer Committee has reported in favor of the separate system of sewerage, with storm-water drains where necessary. Salt-glazed vitrified pipe to be used, not exceeding 24 ins. diameter; cement pipe for the storm-water drains.

Halifax, N. S.—The City Engineer has reported that the proposed sewer on Water St. will be 1,170 ft. long, egg-shaped, and built of concrete blocks. It will cost about $7,000.

WATER-WORKS.

NEW ENGLAND.

Old Town, Me.—The committee of five chosen to make a contract for supplying water have completed and signed a 20 years' contract with Laughton & Clergue. Work will be commenced soon.

Portland, Me.—The Munjoy Hill Reservoir has been completed. The contractor was J. J. NEWMAN, of Providence. Engineer in charge, H. H. MARDEN. Superintendent of construction, H. G. DENNIS. Estimated cost, $125,000. It is provided with a 16-in. outlet main, and has a capacity of 30,000,000 galls. The embankment walls are 47 ft. deep, 150 ft., 30 ft., and 12 ft. thick at bottom, water line and top respectively. Work was begun in June.

Milford, N. H.—The pumps are in position, and will soon be put in operation. Work on the 70-ft. stand-pipe has been begun.

Boscawen and Penacook, N. H.—J. H. ROLFE sends us the following:

The Boscawen & Penacook Water Co. has a charter to build works, but has not decided when construction will be commenced. Estimated cost, $100 000. The supply will probably be taken from Walkers Pond. J. C. PEARSON or I. K. GAGE may be addressed.

Canaan, N. H.—We have received the following information from C. O. BARNEY:

A charter has just been granted to the Crystal Lake Water Co., by the Legislature. No organization has yet been made. The proposed source of supply is Crystal Lake, 1¼ miles from, and 256 ft. above, the town. Estimated cost, $10,000. Population, 600.

Barton Landing, Vt.—Address C. E. JOSLYN for information regarding the proposed works.

Barton, Vt.—Pipe-laying is nearly completed.

Poultney, Vt.—The new works will be completed about Nov. 5.

Lynn, Mass.—An order has been adopted by the City Council authorizing the Water Board to make a survey of the land surrounding Birch and Walden Ponds, and purchase such a portion as is deemed necessary to protect the purity of the water supply.

Cottage City, Mass.—The organization of the Cottage City Water Co. is proposed. Address the Chairman of the Committee on Water Supply.

Boston, Mass.—The following information is taken from remarks recently made by ROBERT GRANT, President of the Water Board:

When the two additional basins now being planned for are added to the city's plant, 49,000,000 galls. of water can be stored for use in dry weather. At present, about 34,000,000 galls. are consumed each year, not taking into consideration the consumption of Charlestown. It is also to be hoped that the resources of the Nashua River will soon be opened.

Newton, Mass.—An appropriation of about $6,000 has been made for new mains and appurtenances.

Fall River, Mass.—The town has appropriated $3,500 for extension.

Leicester, Mass.—Frank L. Fuller, of Boston, Engineer of the new works, has sent us the following list of bids, received Oct. 12:

	Laying 3,300 ft. of 10-in. cast-iron water-pipe.	Laying 650 ft. of 8-in. cast-iron water-pipe.	5 cu. yds. concrete.	10 cu. yds. rubble masonry.	40 cu. yds. clay puddle.	50 cu. yds. rock excavation.	1,000 ft. B. M. timber foundations.	1,000 lin. ft. piling in place.	50 ft. B. M. caps for piles including treenails, in place.	400 cu. yds. extra excavation.	600 cu. yds. gravel filling.	Totals.
Thomas Hennessey,	$0.23	0.23	6.50	4.50	0.75	4.00	25.00	0.125	75.00	0.25	0.25	
Jeffersonville,	$759	149.50	32 50	45.00	30.00	200.00	25.00	225 00	37.50	100.	150.00	$1,753.50
M. Sullivan,	1.00	1.00	5 00	5.00	2.00	3.00	30.00	0.50	50.00	0.50	0.75	
Little Falls, N. Y.	3,300.	$650.	25.00	50.00	80.00	150.00	30.00	900 00	25.00	200.	450.00	$5,860.00

Paxton, Mass.—The work being done at this place is in connection with the new works being constructed at Leicester. FRANK L. FULLER, of Boston, has charge of the matter.

Meriden, Conn.—Improvements and extensions are contemplated.

MIDDLE.

Bay Shore, L. I., N. Y.—The company is pushing the construction of the new works as rapidly as possible.

Saratoga Springs, N. Y.—The new 8,000,000-gall. Gaskill engine, furnished by the Holly Mfg. Co., of Lockport, N. Y., has been officially tested and accepted.

Albany, N. Y.—A new proposition to supply the city with water has been brought forward, which contemplates the construction of a pipe line from Dunsbach's Ferry, where there is said to be a water-power capable of raising between 7,000,000 and 8,000,000 galls. daily to a height of 130 ft. This elevation is nearly 50 ft. higher than the Prospect hill reservoir.

Canton, N. Y.—L. I. RICHARDSON, Superintendent, informs us that the new works will be completed about Nov. 15. The supply is pumped from the river to a 170,000-gall. stand-pipe.

New Brunswick, N. J.—An effort is being made by the Board of Health to secure a pure water supply.

Jersey City, N. J.—The Board of Alderman has passed a resolution denouncing the scheme of the water syndicate to furnish the city with a new supply of water as a swindle, and urges the Mayor and the Finance and Water Boards not to sanction a contract with any private corporation or individual for a new supply.

Annville, Pa.—We have received the following from C. DEAN:

The Annville Water Co. is now negotiating for water rights. The reservoir site has not been selected. Work will be begun in the spring. The officers are: H. H. KREIDER, President; C. DEAN, Secretary; O. H. HENRY, Treasurer. Population, 1,800.

Pen Argyle, Pa.—A. C. YOUNG, Town Clerk, has sent us the following:

The Pen Argyle Water Co. has awarded a contract to T. M. LESHER, and about half of the work is already completed. Manager, W. W. GIBBS. Engineer, J. MARSHALL YOUNG. Water will be conveyed by gravity from a spring in the Blue Mountains to a reservoir. Population, 3,000.

Centreville, Md.—The new works will be completed about Dec. 1.

SOUTHERN.

Alexandria, Va.—Additional mains are being laid by the company.

Hendersonville, N. C.—A gravity system of works is to be constructed. Estimated cost, $20,000. The town will probably let a contract for works completed. Address W. L. HYMAN.

Rutherfordton, N. C.—C. BURNETT, Mayor, has sent us the following:

Works are wanted for domestic use and fire protection. The proposed plan is to pump water from three large springs to a stand-pipe. No contracts have been let. Information can be obtained from FRANK COXE, President of the C. C. & C. Ry., Asheville, N. C. Population, about 900.

Darien, Ga.—The following information is from THOMAS A. BAILEY:

Negotiations are in progress for capital with which to build works. It has not been definitely decided whether the town will construct them or grant a franchise. Water will be pumped from artesian wells to a tank. Address ABBOTT THOMAS, Cashier Darien Bank.

Attalla, Ala.—It is reported that JAMES NORFLEET, of Fort Payne, is negotiating to construct the new works.

Fayetteville, Tenn.—J. E. THOMPSON, of Manchester, is investigating with a view of constructing works.

NORTH CENTRAL.

Marietta, O.—The contract for constructing works will be let Oct. 30. Address GEORGE WEISER, City Clerk, for specifications. The city has sold $90,000 of 4½ per cent. bonds to Seasongood & Mayer, of Cincinnati.

Cincinnati, O.—Petitions presented to the City Council for additional mains have been referred to Superintendent MOORE.

Columbus, O.—Superintendent A. H. MCALPINE informs us that the following bids have been received for constructing the new engine and boiler rooms: Jos. Hamberger & Co., $34,900; F. Fornof, Sr., $13,850; Chas. Guthiel, $53,500; Wittenmeier Bros., $63,800.——A resolution has been adopted by the trustees to petition the next session of the Legislature for authority to issue $150,000 of bonds for extending pipe lines and improving the works generally in 1890.

Red Jacket, Mich.—The question of building works is being discussed.

Adrian, Mich.—W. R. COATS, of Kalamazoo, has made a report to the city on the quality and quantity of water now being furnished by the company.

Somanauk, Ill.—JNO. MCNAMARA, City Clerk, has sent us the following:

Clark & Co. have been awarded the contract for building a $6,000 system of works. They will be completed about Dec. 1. Water will be pumped by a windmill to a tank. H. WRIGHT is Chairman of the Water Board. Population, 800.

Springfield, Ill.—The West Chicago Water & Pipe Line Co. has been incorporated for the purpose of constructing and operating pipe lines wherever and for whatever they may be utilized. Capital stock, $1,000,000. The incorporators are: A. CRAWFORD, PARK E. SIMMONS and R. R. HERTZOG.

Peoria, Ill.—The report of the Special Committee on Water Supply, favoring the acceptance of the proposition submitted by the new company, has been adopted. The supply will be pumped from wells to a reservoir.

Taylorville, Ill.—A small amount of new mains have been ordered laid by the City Council.

Eagle River, Wis.—Works costing $7,000 are to be constructed. Interested parties are M. HOLLAND, D. GRAHAM, T. B. WELSH, and L. J. COOK.

Kilbourn City, Wis.—We have received the following from H. A. STILLMAN:

Contracts for complete works will soon be let. Estimated cost, $6,000; to be raised by taxation. The supply will be pumped from the river to a tower or stand-pipe. C. W. SNYDER is Chairman of the Water Board. Population, 1,200.

NORTHWESTERN.

Plainview, Minn.—A committee has been appointed to investigate plans for furnishing the town with fire protection. It is probable that a well will be sunk.

Mankato, Minn.—About 10,000 ft. of new mains will be laid in connection with the other improvements.

Meade, Kan.—We have received the following information from M. CLABAUGH:

The Meade Centre Gas, Fuel & Water Co. is to build works for domestic use and fire protection. Water will be pumped from artesian wells to a stand-pipe. The officers are: JAMES WILSON, President, (?); W. H. YOUNG, Secretary. Population, 1,000.

Randolph, Neb.—The town has issued $2,800 of bonds to raise money for works.

Loup City, Neb.—G. W. KITTLE is reported as stating that works are contemplated, the supply to be conveyed through a canal, 13 miles long. [The fact probably is, that a canal only is to be built, as works costing $10,000, for fire protection and domestic supply, were built by the city in 1887-88.—ED.]

Gothenburg, Neb.—Franklin & Carroll have been awarded the contract for constructing works, by the Gothenburg Canal Co. Estimated cost, $50,000. Hydrants will be used. Engineer, C. W. STANCILL. Work is to be completed June 1, 1890. Population, 500.

Iroquois, Dak.—We have received the following from F. L. GILBERT:

All contracts will probably be let early in November. The supply will be taken from artesian wells.

Parker, South Dak.—F. L. CLISTY sends us the following:

A contract has been let for works to be completed by April 1, 1890. R. E. BUCHANAN is Chairman of the Water Board. Water is to be pumped from an artesian well to a tank. Estimated cost, $4,000. Population, 800.

Fort Russell, Wyoming.—The contract for construction has been awarded to M. P. Keefe, of Cheyenne. Work will be commenced at once.

Helena, Mont.—The report of the Water Committee, recommending that the city contract with the Woolston Water Co. for a term of five years, has been adopted by the City Council.

SOUTHWESTERN.

Butler, Mo.—We have received the following information from F. W. SILVERS:

The construction of works will be begun about Nov. 1 by a private company. H. S. DEWEY, of Jefferson City, Mo., is the Engineer, and may be addressed for all information. The estimated cost is $60,000. Water will probably be pumped from the Miami River to a stand-pipe. Population, 5,000.

Vernon, Tex.—It is reported that works are to be constructed.

Eagle Pass, Tex., and Porfirio Diaz, Mexico.—F. H. HARTZ, President of the Eagle Pass Water Co., sends us the following:

The company has been granted a 40 years' franchise and will construct works costing about $27,000. Water will be pumped from the Rio Grande River to a tank. Contracts will be made for works to be built in Porfirio Diaz, Mexico, across the river. The latter city will use fire hydrants. Pumping machinery will be established in both places and so arranged that water can be pumped to either place by either pump, or the capacity of both combined to convey water to either place at one time. The officers are: F. H. HARTZ, President; M. HARTZ, Secretary; ED. SCHMIDT, Treasurer.

Wray, Col.—A large majority vote has been cast in favor of issuing bonds for a complete system of works.

Crested Butte, Col.—Work has been resumed, and the new works will be pushed to speedy completion.

Colorado Springs, Col.—The Austin Bluff Land & Water Co. has awarded the contract for the construction of a 100,000,000-gall. storage reservoir, to be built near the headwaters of West Monument Creek, to Moore & Clough, of Denver. The construction of this reservoir will perfect the company's system.

Petersburg, Col.—A well is being sunk by Comstock Bros. for the South Denver Water Co.

Springfield, Col.—L. A. ANDERSON, Chairman of the Water Board, sends us the following:

Contracts for building works, furnishing supplies, etc., will be let by the Town Council about Nov. 1, works to be completed by March 1, 1890. Bonds for $5,000 have been voted. The supply will be taken from artesian wells.

Denver, Col.—At a recent meeting of the Board of Aldermen, an ordinance was passed granting a franchise to the Citizens' Water Co. to lay mains in all the streets, and furnish water to private consumers.

PACIFIC.

Sprague, Wash.—The following information is from W. B. LOTTMAN.

The contract for building works has been awarded to John Corkish, of Portland, Oregon. A compound duplex Knowles pump, of 500 galls. per minute capacity will be provided, and a reservoir of 10,000 to 20,000 galls. capacity constructed.

Port Townsend, Wash.—It is proposed to lay a main from the reservoir, to form which a dam is now being constructed, to connect with the city's pipe system, and then abandon the present source of supply. The work is being done by the company.

North Yakima, Wash.—J. D. MCINTYRE states that work will be commenced soon. The company has decided to use 16-in., instead of 12-in. pipe, for the mains.

Seattle, Wash.—BENEZETTE WILLIAMS, of Chicago, has been engaged as Consulting Engineer in the matter of providing the city with an adequate water supply.——At the city election authority was obtained to issue $1,000,000 of bonds for providing an ample water supply.

Waitsburg, Wash.—City Clerk RICHARD H. ORMSBEE has sent us the following information:

The construction of works is urgent, but no surveys have as yet been made. It is probable that surveys will be made, and plans adopted early in the spring. Estimated cost, $15,000 to $20,000. The supply will probably be pumped from Fruchet River to a reservoir. Population, 1,000.

Enterprise, Oregon.—The following information is from L. J. ROUSE:

The Enterprise Water Co. has been incorporated, and will probably build works. Water will be conveyed through a ditch leading from Wallula River. The capital stock is $5,000. No contracts have been made.

McMinnville, Ore.—A. S. COOPER informs us that works are now being constructed to have a daily capacity of 2,000,000 galls. G. GRISSEN is President of the Water Committee.

Portland, Ore.—Excavations have been begun for the foundations for the new pumping station to be located at Palatine Hill.

Albany, Ore.—Articles of incorporation have been filed with the County Clerk for the Albany Canal, Water, Transportation, & Lighting Co. The incorporators are: C. C. HOGUE, A. BENSELL, J. O. WILSON, and J. L. RIPLEY. Capital stock $300,000, divided into 3,000 shares of $100 each. They have purchased and propose operating the Santiam Canal, Albany water-works, electric light and power, factories, and g as works.

Montrose, Col.—F. H. REINHOLD, Superintendent, informs us that a contract has been awarded to the Erie City (Pa.) Iron Works for furnishing a 45 H. P. boiler.

Paso Robles, Cal.—We are informed that an attempt is being made to secure works. Blackburn & James may be addressed.

Moscow, Idaho.—LINDEL SMITH, Mayor, has sent us the following:

The contract for constructing a Holly system of works has been awarded to G. H. Sutherland, of Walla Walla, Wash. Work will be commenced about Nov. 16 and completed in Feb., 1890. Estimated cost, $25,000. Bonds for that amount have been sold. The supply will be taken from driven wells. Population, 1,500.

Salt Lake City, Utah.—The city has sold $50,000 of bonds. The money is to be used in extending and improving the works.

CANADA.

West Toronto Junction, Ont.—The town has voted to expend $10,000 for securing better fire protection.

Barre, Ont.—HENRY BIRD, Town Clerk, sends us the following:

The question of building works is again being discussed. A vote will probably be taken in January, 1890. A vote of the citizens was taken a few years ago, and the project defeated.

Lucknow Ont.—The new works will be completed about Dec. 1. McQuillam & Co., of Toronto, are the contractors. Water is pumped from Two Rivers to a tower.

Newmarket, Ont.—DAVID LLOYD informs us that a considerable amount of extensions are to be completed this fall.

FOREIGN.

Paila, U. S. of Col. S. A.—At a joint session of senators and deputies, a bill was approved authorizing the establishment of a water service.

ARTESIAN WELLS.

Gainesville, Fla.—Arrangements are being made for sinking of an 8-in. well.

East St. Louis, Ill.—The Cook Well Co., of St. Louis, Mo., has finished 2 wells for the Tudor Iron Works, and 2 for the East St. Louis Packing & Provision Co. Water was struck at a depth of 70 ft. Pumps will soon be placed.

Richfield, Kan.—A company is being organized in Richfield County to sink wells.

Hempstead, Tex.—Correspondence with well contractors is solicited by JAMES D. MONTGOMERY, Mayor.

Lake Charles, La.—A 510-ft. well has been sunk which flows 25,000 to 30,000 galls. per day. In order to obtain a still greater flow the well has been sunk to a depth of 595 ft.

Laredo, Tex.—A well is being sunk on Laredo Heights.

Forty Mile Desert, Nevada.—A well is to be sunk.

Marlin, Tex.—C. J. MARLIN, City Secretary, will receive bids for sinking a well.

Vernon, Tex.—The town has raised $2,500 for sinking a well. Address the Mayor.

Yankton, Dak.—The twenty-fifth and largest artesian well in Yankton County, at the cement works, has been finished to a depth of 500 ft. It is 8 ins. in diameter.

Huron, South Dak.—The irrigation convention has prepared a memorial to the State Legislature and Congress asking co-operation and material aid in putting into practical operation a system of irrigation by means of artesian wells.

IRRIGATION.

Loveland, Col.—The Hillsboro Ditch & Canal Co. has awarded the contract to N. P. Thompson for replacing a flume near the head of their ditch, with an embankment, and diverting the course of the Big Thompson River. The work is to be completed about Nov. 20.

El Paso, Tex.—ERNEST E. RUSSELL, Secretary of the El Paso Irrigation Co., has awarded the contract for the entire work of constructing its canal to the Rosenfeld Construction Co., of Denver, Col.

Pueblo, Col.—RODNEY ROUNDS, of Lamar, is perfecting the organization of a company whose purpose is to build two or more lines of irrigation ditches in Eastern Colorado. The lines will extend into Western Kansas, where the company has recently purchased several thousand acres of farming land.

Fresno, Cal.—A majority vote has recently been taken in favor of establishing the Sunset Irrigation District. The district embraces territory in Tulare, Fresno, and Merced counties, all lying west of Fresno Slough and San Joaquin River. Bonds will be issued, and work commenced soon.

Truckee, Nevada.—A dam is to be erected at the site of the old Towle mill, which will raise the surface of the lake about 20 ft. This will be used to store water in the spring, and be used in the summer to irrigate land near Reno.

Sacramento, Cal.—The capital stock of the Feather River Canal Co. is $1,000,000. The directors are: A. C. FLEMING, of Lincoln; T. R. FLEMING, of Biggs; J. B. WRIGHT, of Sacramento; P. D. GARDENMEYER, of Yuba City; THEODORE OLMSTEAD, of Wheatland; P. A. HUMBERT, of Folsom, S. C. DENSON, of Sacramento. [Note of the incorporation of this company to construct irrigation works, etc., was given in our issue of Oct. 12.—ED.]

Florence, Ariz.—Bids were received by the Florence Canal Co. on Oct. 21, for constructing about 2½ miles of its irrigating canal.

Raymond, Dak.—The following is from CHAS. PARROTT, Sr.:

This is an excellent field for artesian well contractors to look for employment. The yielding capacity of land in the vicinity has been greatly impaired owing to droughts for the past two seasons, and the only remedy is to establish an irrigation system, taking the supply from wells.

Salt Lake City, Utah.—M. F. STURGES informs us that Pratt Bros. Co. has been incorporated with a capital stock of $250,000. Their object is to develop, buy, and sell water rights.

Piura, Peru, S. A.—At a joint session of the Houses of Senators and Deputies a bill was approved legalizing the development of a large irrigation scheme.